AD-A149 541 POST-FLOOD REPORT MISSOURI RIVER AND TRIBUTARIES SPRING FLOODS 1984(U) CORPS OF ENGINEERS OMAHA NE OCT 84 1/4

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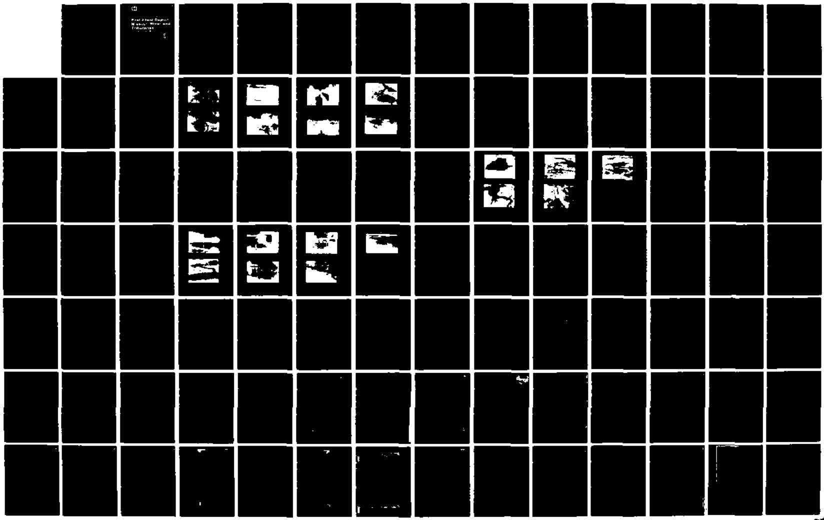

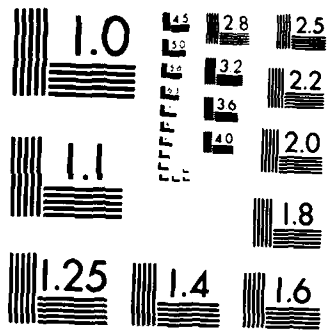
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US Army Corps
of Engineers
Omaha District

Post-Flood Report Missouri River and Tributaries

Spring Floods 1984

October 1984

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DISCLAIMER NOTICE

POST-FLOOD REPORT
MISSOURI RIVER AND TRIBUTARIES
SPRING FLOODS 1984

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POST-FLOOD REPORT
MISSOURI RIVER AND TRIBUTARIES
SPRING FLOODS 1984

I. GENERAL

1. INTRODUCTION

Large areas of the Missouri River basin received intermittent heavy rainstorms during the months of May and June 1984. Above average precipitation also occurred during the preceding months. The prolonged wet spring culminated with flooding in June. The flooding was the worst since the disastrous flooding in 1952. Within the Omaha District boundaries, most of the damage occurred in southeastern South Dakota, western Iowa, eastern Nebraska, and northwestern Missouri. Numerous towns and riverfront developments were flooded or threatened with flooding. Many roads and bridges were washed out or damaged. Millions of acres of land were flooded or damaged by soil erosion. Thousands of acres of cropland were not planted because of the magnitude and timing of the flooding, causing a severe financial hardship for farmers. Initial reports were that 11 lives were lost because of flooding; however, only 2--in the Salt Creek basin--could be substantiated. Combined, the rainfall and flooding caused hundreds of millions of dollars worth of damage in the Omaha District. Rare event high flows in the Beaverhead River and Ruby River basins in Montana and on the rivers upstream from the reservoirs in the North Platte River basin were also experienced.

The tributary river basins in which flooding or high flows occurred were the Beaverhead River and Ruby River basins in Montana; the Vermillion River, James River, and Big Sioux River basins in South Dakota; the Big Sioux River, Little Sioux River, and Nishnabotna River basins in Iowa; and the Salt Creek, Papillion Creek, Elkhorn River, and North Platte and Platte River basins in Nebraska. The flooding in most of these basins contributed to high flood stages on the Missouri River. Many other smaller tributary basins experienced flooding, but they are too numerous to mention. A map of the Missouri River basin is shown on plate 1.

2. AUTHORITY

This post-flood report was prepared in conformance with the requirements of ER 500-1-1, "Natural Disaster Procedures." The report describes the 1984 spring flood conditions throughout the Missouri River basin in the States of Iowa, Montana, Nebraska, South Dakota, and Wyoming.

A Category C flood emergency for the Omaha District was declared on 17 May 1984 in accordance with the provisions of the District's Annex A&B to ER 500-1-1. Flood emergency assistance, authorized by Public Law 99, 84th Congress, hereinafter referred to as Public Law 84-99, was initially undertaken by the District. This assistance consisted of providing the States of South Dakota, Iowa, Nebraska, and Missouri with technical advice

and supplementing their flood-fighting equipment and supplies when their resources were exhausted. When Presidential Disaster Declarations were made for the States of Missouri (21 June 1984), Nebraska (26 June 1984), Iowa (27 June 1984), and South Dakota (19 July 1984), the Federal Emergency Management Agency (FEMA), through the Missouri River Division, assigned the Omaha District other disaster assistance activities under Public Law 93-288. These activities included providing personnel to complete preliminary damage assessments, damage survey reports, and final inspection reports for FEMA Regions VII and VIII. The Category C flood emergency was rescinded on 9 July 1984. On 10 July, a Public Notice was issued to inform the public of the Corps' levee rehabilitation program authorized by Public Law 84-99. Under the rehabilitation program, the Corps can repair or restore any flood control work, public or private, that is damaged or destroyed by floods. However, the structure to be repaired or restored must either by itself prevent flooding from rising water or be an integrated part of a flood control system. Rehabilitation work to protect a single owner's project may be done only if the project is economically feasible (benefits exceed costs). Repair work is primarily limited to restoring the damaged structure to its predisaster cross section, line, and grade. The Corps is authorized to spend up to $2,500 for the field investigation of each request or project following a flood event. As of 10 October 1984, the Omaha District had received 175 requests for rehabilitation assistance.

3. PURPOSE

The purpose of this post-flood report is to provide a record of the flooding that occurred in the Missouri River basin in the spring of 1984 with respect to the hydrometeorological data, areas flooded, physical damages inflicted, loss of life, financial and economic losses, and damages prevented by existing projects.

4. SCOPE

This report presents the data compiled regarding the causes of the flooding, the streams on which flooding occurred, the areas flooded, the records of inflow, the reservoir releases, the high-water marks established, the loss of life, the physical damages inflicted, the financial and economic losses incurred, and the damages prevented by existing projects. It was necessary, at times, to use very broad descriptions of these data because exact figures were not available.

Requests for assistance under Section 14 of the 1946 Flood Control Act, as amended, are also addressed in this report. The requests mentioned pertain only to those conditions that were brought about or aggravated by the 984 spring flooding. Under Section 14, the Corps is authorized to spend up to $250,000 in a single locality for emergency streambank protection to prevent flood damage to highways, bridge approaches, public works and utilities, churches, hospitals, schools, and other nonprofit public services. This authority does not apply to privately owned property.

Because this report covers flooding on numerous tributary streams in addition to the Missouri River main stem, several streams will be grouped together in sections for easy discussion.

5. SOURCES OF INFORMATION

a. Meteorological Data. Meteorological data were obtained from the National Weather Service, U.S. Geological Survey, gaging equipment operated by the Omaha District, and "bucket surveys" made by Omaha District survey teams. Other data were obtained from the Papio Natural Resources District.

b. Hydrologic Data. Hydrologic data were obtained from the U.S. Geological Survey, the Bureau of Reclamation, the Soil Conservation Service, various State agencies, and the Papio and Lower Platte South Natural Resources Districts and from gaging equipment operated by the Omaha District

c. Flood Data. The limits of flooding were determined from post-flood inspections, field surveys, and aerial photographs. The Corps also set and surveyed high-water marks. Many of these high-water marks are shown on plates in this report and tabulated in a list presented as exhibit A. High-water marks other than those presented in this report may be obtained from Omaha District files.

d. Flood Damages and Estimates of Flood Damages Prevented. Estimates of the flood damages were compiled by the Omaha District from field surveys and from data received from the American Red Cross, several Federal agencies, State Civil Defense agencies, State Soil Conservation Service offices, regional planning agencies, and various county and city government offices. Nebraska's Natural Resources Districts also provided information. Some estimates of flood damages prevented were also compiled by the Omaha District.

Agricultural damages in the flood plains were estimated using state crop budget data and current normalized prices and were based on the areas flooded and the land use. Approximately one-half of the land was planted at the time of inundation. The other half had not been planted or prepared for planting because of heavy precipitation earlier in the spring. Land use of cropland in the flood plains is normally 50 percent corn and 50 percent soybeans. Agricultural losses were based on the fixed costs of production plus 50 percent of the variable costs associated with planting corn and soybeans. This does not take into account the costs associated with planting the short-season crops after the flooding which did not mature because of the early frost.

e. Other Reports. The following are reports on the 1984 spring flooding that were prepared by the FEMA Region VII Interagency Hazard Mitigation Team.

- Interagency Flood Hazard Mitigation Report in Response to the June 21, 1984, Disaster Declaration, FEMA-713-DR-MO.

- Interagency Flood Hazard Mitigation Report in Response to the June 26, 1984, Disaster Declaration, FEMA-716-DR-NE.

. Interagency Flood Hazard Mitigation Report in Response to the July 19, 1984, Disaster Declaration, FEMA-717-DR-SD.

These FEMA reports were developed to provide the framework for flood hazard mitigation during the reconstruction process as a means of reducing the potential for future flood losses. They describe the flooding--the causes, extent, hydrological data, history, problems, and damages.

II. UPPER MISSOURI RIVER UPSTREAM FROM CANYON FERRY DAM

1. BASIN DESCRIPTION

a. Topography. The southwestern portion of Montana, in which the headwaters of the Missouri River are located, is characterized by the high precipitous slopes of the Rocky Mountains. To the east, the area consists of rolling and partly dissected plateaus typical of the Great Plains area of the United States. The mountainous area is highly folded and faulted. Surface soils vary considerably and range from a loose sandy loam to a heavy clay. Considerable areas of gravel-shot soil occur in different localities; this soil is sometimes too coarse to permit cultivation. In the Jefferson River basin, a large swamp-like area is located above Lima Reservoir.

b. Climate. The area east of the Continental Divide in Montana lies mostly within the semiarid zone, but there are marked climatic differences between the plains and the mountains. Summertime in the area generally is quite pleasant; nights are cool, days are moderately warm and sunny, and there is relatively low humidity. Cold waves, blizzards, and the warm chinook are features of the winter season.

c. Precipitation. The average annual precipitation varies from 11 to 18 inches at lower elevations to 30 inches or more in the mountains. Normally about 70 percent of the yearly moisture falls during the period from April through September, with May and June being the wettest months.

d. Runoff Characteristics. The normal sequence of runoff in this region is low winter flows, augmented in March and April with snowmelt runoff from the plains area. During the May through July period, another increase in runoff takes place when the snowpack in the higher elevations melts. The flows are often augmented during this period by rainfall runoff. Late summer and fall usually find a return to the low flows that prevail until the cycle begins again in the spring.

2. WATER PROJECTS

a. Description of Projects. There are two Bureau of Reclamation reservoirs in the Missouri River basin upstream from Great Falls, Montana, that have space allocated for flood control--Clark Canyon Reservoir and Canyon Ferry Reservoir. When runoff starts to fill the flood storage zone in these reservoirs, release rates become the responsibility of the Omaha District.

Clark Canyon Dam and Reservoir, authorized by the Flood Control Act of 1944, was completed in 1964. The project is used for irrigation, flood control, fish and wildlife, water supply, and recreation. The dam, an earthfill and rockfill structure with an ungated ogee crest spillway, is located where the Beaverhead River is formed by the confluence of the Red Rock River and Horse Prairie Creek.

Canyon Ferry Dam and Reservoir, authorized by the Flood Control Act of 1944 and completed in 1953, is located on the Missouri River approximately 15 miles east of Helena, Montana, in Lewis and Clark County. The project is used for irrigation, power production, flood control, fish and wildlife, recreation, and water supply. The dam is a concrete gravity type with a radial gated spillway. In 1966, by agreement between the Bureau of Reclamation and the Corps, reservoir storage space was allocated for flood control.

b. Mountain Snow Runoff Forecasts of Water Projects. Forecasts of snowmelt runoff volumes are prepared by the Corps early each month, January through June, for selected reservoirs in the Missouri River basin that have space allocated for flood control. Forecasts are based on mountain snowpack, rainfall, and antecedent conditions from the previous fall. These forecasts are compared with similar ones made by the Bureau of Reclamation, Soil Conservation Service, and National Weather Service. Table 1 summarizes the result of the Corps' 1984 forecasts for Clark Canyon and Canyon Ferry Reservoirs. Also included is the actual runoff at both reservoirs for the period forecasted.

Table 1
Snowmelt Runoff
Clark Canyon and Canyon Ferry Reservoirs

Reservoir	1984 Runoff Forecasts 1/			
	1 March	1 April	1 May	1 June
Clark Canyon (Apr-Jun)	143	154	177	135
Canyon Ferry (Apr-Jul)	113	135	140	130

Reservoir	1984 Actual Runoff
Clark Canyon (Apr-Jun)	289,080 acre-feet (241 percent of average)
Canyon Ferry (Apr-Jul)	3,000,400 acre-feet (155 percent of average)

1/ Percent of average

3. 1984 FLOODING

a. Meteorology. Warm temperatures in the mountains of Wyoming and Montana during mid-May accelerated the melting of the snowpack. Moderate rainstorms during the period of 14-16 May added to the snowmelt runoff and caused serious flooding on some streams in the foothill areas. Plates 2 and 3 show mass rainfall curves from selected precipitation stations located within the storm area for the months of May and June.

b. Description of Flooding. Increased snowmelt runoff because of the warm temperatures in mid-May, combined with the moderate rainfall that fell at the same time, caused flooding on many of the streams in the foothills of

southwestern Montana. Although the Missouri River downstream from Canyon Ferry Dam stayed within its banks, the Beaverhead River downstream from Clark Canyon Dam went over its banks, causing minor overland flooding. Blacktail Creek, which runs through the town of Dillon before it joins with the Beaverhead River, went overbank as the result of the rainfall in June. Part of the Blacktail Creek flow was routed through a city street using hay bales and railroad ties, much the same way as floodwater was routed in the highly publicized event in Salt Lake City in 1983. Photos of the high water that occurred are shown as figures 1 through 8. A list of selected stream gaging sites within the Missouri River basin is presented as exhibit B. A few stations in the basin upstream from Canyon Ferry Dam are shown. Exhibit B also presents data on flood conditions and compares the stages and peak discharges of the flood of record with the 1984 flooding.

4. RESERVOIR REGULATION DURING THE 1984 RUNOFF PERIOD

The hydrologic conditions that set the stage for Clark Canyon Reservoir's record inflows in the spring of 1984 included a very wet fall in 1983 and an extremely cold December. The rainfall in the fall of 1983 caused the pool level to rise into the replacement-local flood storage zone on 23 October. As outflows were increased to evacuate storage, the inflows continued to stay high. As a result, the pool level continued to slowly rise. The extreme cold in December forced the outflows to be reduced to alleviate ice problems in the river downstream. Early in January 1984, the Corps requested that the project be operated for main stem replacement storage purposes. In January and February 1984, the pool level was lowered to evacuate the replacement-local flood storage zone. Filling of this zone was initiated in March. The pool continued a slow climb until mid-May when warm weather and heavy precipitation began to occur, which caused a sharp rise in the pool level. The pool elevation rose above the top of the flood storage zone on 5 June and the Clark Canyon spillway was used for the first time. The pool peaked on 25 June with 4.3 feet of water flowing over the spillway. Releases over the spillway continued until 15 July. The exclusive flood storage zone was evacuated by 2 August. The replacement-local flood storage zone was evacuated by 14 September. Plate 4 shows the pool elevation, inflow, and outflow at Clark Canyon Reservoir during the spring of 1984, along with the flow at the stream gage located at the southwest edge of Dillon. This gage served as the control point during most of the flood operation period.

Based on field observations made during the 1984 flood, a flow of 1,600 c.f.s. at the stream gage located at the southwest edge of Dillon was determined to be the approximate nondamage discharge in the city.

The above average snowpack upstream from Canyon Ferry Dam early in the winter indicated an above average runoff forecast for the reservoir. When augmented by rainfall in May and June 1984, the inflow into Canyon Ferry Reservoir caused the pool level to enter the exclusive flood storage zone on 20 June and stay there until 4 August. Plate 5 shows the pool elevation, inflow, and outflow at Canyon Ferry Reservoir during the spring and summer of 1984.

Figure 1. View of Beaverhead River at Dillon, Montana, 22 June 1984. (Discharge - 2,300 c.f.s., Gage Height - 7.3 feet)

Figure 2. View of Beaverhead River at Dillon, Montana, 22 June 1984. (Discharge - 2,300 c.f.s., Gage Height - 7.3 feet)

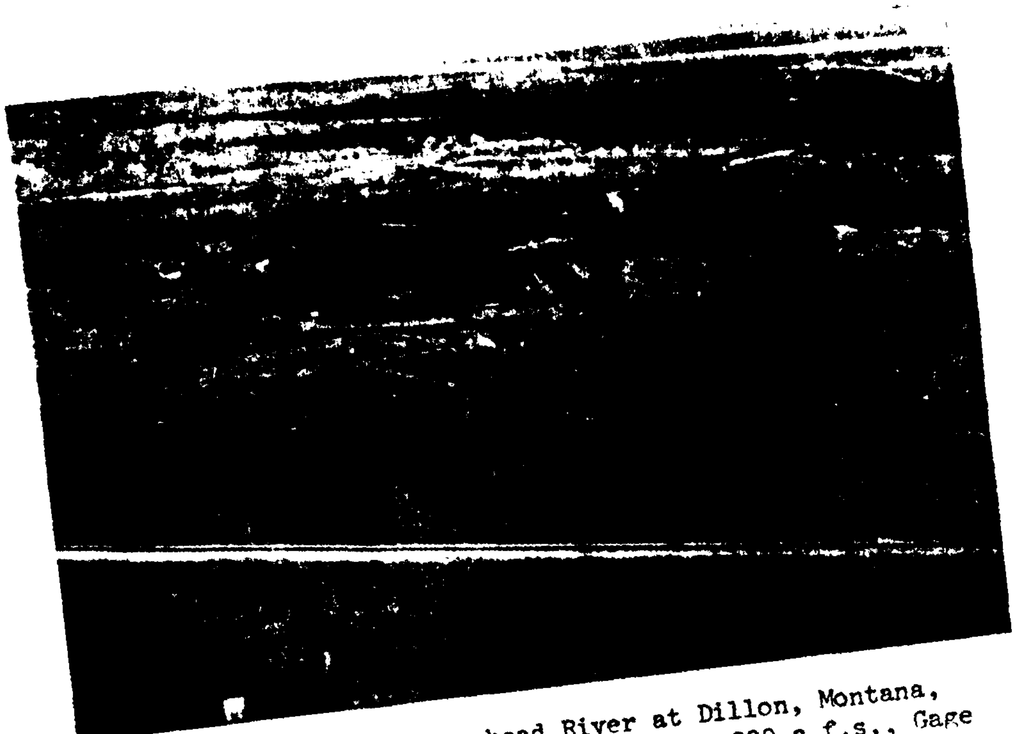


Figure 3. View of Beaverhead River at Dillon, Montana, 22 June 1984. (Discharge - 2,300 c.f.s., Gage Height - 7.3 feet)

Figure 4. View of Beaverhead River at Dillon, Montana, 22 June 1984.

Figure 5. View of overflow from Blacktail Creek being routed down a city street in Dillon, Montana, 22 June 1984.

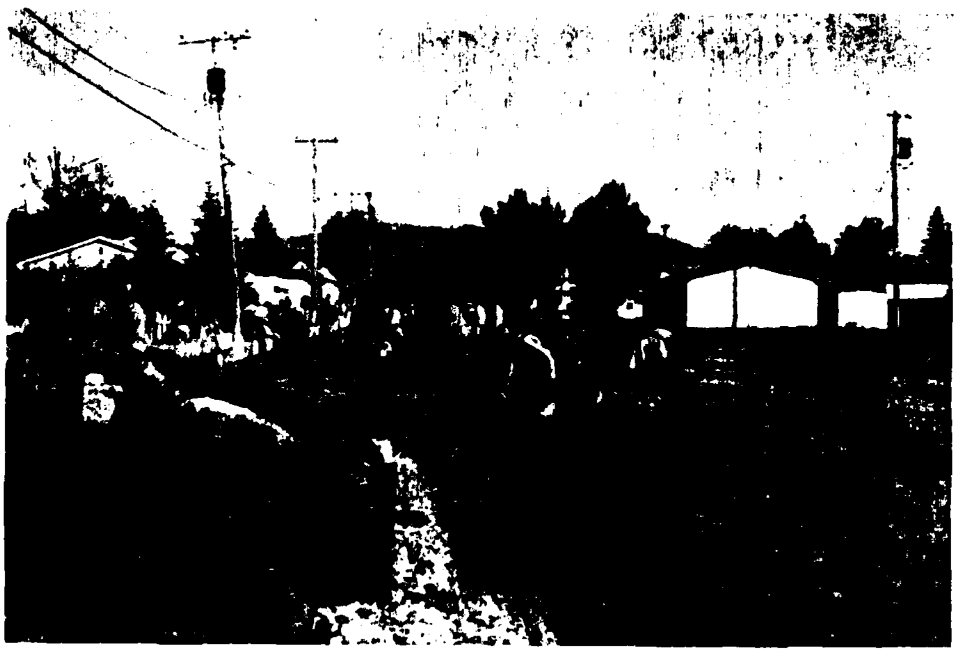


Figure 6. View of overflow from Blacktail Creek being routed down a city street in Dillon, Montana, 22 June 1984.

Figure 7. View of Lima Reservoir on the Red Rock River in Montana, 22 June 1984. (Discharge - 1,450 c.f.s.)

Figure 8. View of an estimated 100-year event on the Beaverhead River near Barretts, Montana, 22 June 1984. (Discharge - 3,000 c.f.s., Gage Height - 5.1 feet)

In an effort to reduce downstream flows, both Canyon Ferry and Clark Canyon Reservoirs stored considerable runoff in their flood storage zones. At Clark Canyon Reservoir, 100 percent of the 129,000-acre-foot flood storage zone was utilized, along with 36 percent of the 71,800-acre-foot surcharge zone. At Canyon Ferry Reservoir, 71 percent of the 104,300-acre-foot exclusive flood storage zone was utilized.

5. DAMAGES

Extensive damage to bridges and roads occurred in the Beaverhead and Ruby River basins because of flooding. Numerous bridges had to be either repaired or replaced. The Montana State Disaster Emergency Service Office estimated the damages to bridges at $483,000 and the damages to roads at $140,000. Private and State flood fight costs are estimated to be $40,300.

Table 2 presents the amount of damages prevented by Bureau of Reclamation reservoirs during Fiscal Year 1984.

Table 2
Summary of Flood Damages Prevented by
Bureau of Reclamation Reservoirs
in the Missouri River Basin
During Fiscal Year 1984

Reservoirs	Damages Prevented
North Platte Projects	$ 801,000
Clark Canyon	2,014,000
Canyon Ferry	9,624,000
Tiber	1,756,000
Boysen	2,234,000
Yellowtail	4,250,000
Heart Butte	17,000
Shadehill	256,000
Keyhole	498,000
Pactola	--
Total	$21,450,000

III. MISSOURI RIVER TRIBUTARIES
GAVINS POINT DAM TO OMAHA, NEBRASKA

1. GENERAL

Major tributaries downstream from the control of the main stem reservoirs to Omaha, Nebraska, include the James, Vermillion, Big Sioux, Floyd, Little Sioux, Soldier, and Boyer Rivers. These tributary rivers receive runoff from the eastern one-third of North and South Dakota and the western quarter of Iowa. Contributions to the total flow of the Missouri River passing Omaha are commensurate with the total drainage areas of these river basins, which are listed in table 3.

Table 3
Major Missouri River Tributary Drainage Areas
Gavins Point Dam to Omaha, Nebraska

River	Drainage Area (square miles)
James	22,100
Vermillion	2,185
Big Sioux	9,415
Floyd	985
Little Sioux	4,550
Soldier	530
Boyer	1,085

2. DESCRIPTION OF THE AREA

a. Topography. The eastern portion of North Dakota is characterized by black loamy soil of various depths, underlain with a subsoil of clay. The eastern portion of South Dakota has a limy soil, but it is arable, fertile, and suitable for growing crops. The prairie lands east of the Missouri River are dotted by numerous small ponds and lakes, some of which dry up during drought periods. The James River has an extremely low gradient and flows are consequently sluggish. Water falling on much of the eastern area of South Dakota does not reach the stream valleys at all but lies in depressions until it evaporates or soaks into the ground. The topography of the western Iowa river basins varies from loess hills that are subject to erosion to the alluvial bottom lands bordering the Missouri River.

b. Precipitation. Average annual precipitation ranges from 18 inches in the upper James River basin to 28 inches in western Iowa. Approximately 75 percent of the total rainfall occurs during the 6-month growing season from April through September. Although floods are most frequent in June during the normal maximum rainfall period, they also occur near the end of March, usually as a consequence of rain on frozen ground or rain and rapid snowmelt. Ice jams often occur with spring flooding.

3. WATER PROJECTS

Major projects on the upper James River include Jamestown Reservoir, built by the Bureau of Reclamation; Pipestem Lake, built by the Corps; and Columbia Road and Houghton Dams/Sand Lake National Wildlife Refuge, operated by the U.S. Fish and Wildlife Service. These projects have a minimal effect on the flow contribution to the Missouri River. This is due in part to the long distance, relatively flat gradient, and heavy irrigation demands. There are numerous Soil Conservation Service dams, check structures, and private agricultural levees in the tributary river basins downstream from Gavins Point Dam. In addition, the Corps constructed a number of flood control projects. Some notable projects include the Big Sioux River diversion project at Sioux Falls, South Dakota; the Big Sioux River and Floyd River flood and erosion control projects at Sioux City, Iowa; the Ida Grove project on the Maple River; the Dry Creek project at Hawarden, Iowa; and the Blackbird Creek project at Macy, Nebraska.

4. 1984 FLOODING

a. Meteorology. The 1984 spring flooding resulted from intermittent heavy rainfall. The heaviest storms occurred during the period of 12-16 June in eastern Nebraska and western Iowa and during the period of 19-22 June in eastern South Dakota.

Weather over the central United States during the period of 12-16 June was characterized by a near stationary jet stream aloft, which was maintained in its position over the northern Great Plains by a blocking high pressure ridge over the southeastern United States. This upper level circulation pattern persisted for a considerable length of time, thus prolonging an unstable condition over the region. Warm, moist air flowing northward interacted with an unusually cold mass of air moving into the northern plains; this resulted in severe weather and heavy downpours of rain which caused widespread flooding in the lower Missouri River Valley from South Dakota to the Omaha District's border and downstream to St. Louis, Missouri.

Under the influence of the southwest-northwest oriented jet stream, an instability line, a frontal wave, and a low pressure center with its associated occluded front moved through the Nebraska-South Dakota area, resulting in heavy rainfalls of 6 inches or more nearly every day somewhere in the area during this period. The greatest 1-day precipitation amount reported for any National Weather Service recording precipitation station in the storm area during this period was 7.42 inches at Weeping Water, Nebraska, on 12 June.

Plates 6 and 7 show mass rainfall curves from selected precipitation stations located within the storm area for the months of May and June. Plates 8 and 9 show the total monthly precipitation for June for Nebraska and South Dakota.

b. <u>Description of Flooding</u> The tributary basins downstream from Gavins Point Dam were subject to two independent high-water periods in April and June. Farm activities were restricted and crop planting was delayed because of the excessive wetness and standing water. Saturated soil conditions, combined with heavy periods of precipitation in June, forced many of the tributaries out of their banks. Record discharges were reported on Bow Creek at St. James, Nebraska; the James River near Scotland, South Dakota; and the Vermillion River near Wakonda, South Dakota. Iowa had the wettest April in 112 years; this condition helped sustain flows above flood stage throughout the western portion of the State.

Plates 10 through 17 contain plots of the river stages based on the data received from the Omaha District's data collection platforms.

Data on flood conditions are presented in exhibit B. The data provide a comparison of the stages and peak discharges of the flood of record with the 1984 flooding.

5. DAMAGES

In South Dakota, the Big Sioux and Vermillion Rivers flooded for the second year in a row and the James River downstream from Scotland had record flows. Numerous small private levees broke or were overtopped, flooding much of the farmland in the valleys and causing extensive damage. Most of the roads and highways in the flooded areas were severely damaged by erosion.

The South Dakota Emergency Disaster Service made a flood damage survey of a 15-county area of southeastern South Dakota. It was estimated that within this area there were damages of $2,530,000 to public facilities, $110,500 to State facilities, $500,000 to businesses, and $475,000 to individual property owners. These damage figures also include damages caused by interior flooding conditions. The U.S. Department of Agriculture estimated that, within this same predominantly agricultural area, there were 2.04 million acres of cropland affected by the flooding and interior drainage problems--about 40 percent of the total acreage. The total crop damage was estimated to be $200 million. This figure is somewhat lower than original damage estimates because some replanting was possible. This information was obtained from the Interagency Flood Hazard Mitigation Report, FEMA-717-DR-SD, dated 2 August 1984.

The Farmers Home Administration declared a larger 23-county area as a disaster area and estimated that over 1 million acres of cropland were inundated with another 1.5 million acres inaccessible. It's original crop loss estimate was $283 million.

Approximately 249 dwellings in a nine-county area were affected by flooding, according to the American Red Cross. Of the dwellings, 1 house was destroyed, 13 houses had major damage, and between 110 and 193 houses had minor damage. Basement flooding was widespread. Three mobile homes received major damage. The Small Business Administration indicated that eight businesses incurred physical damages amounting to $100,000. This figure

includes the loss of both inventory and income. Damages to roads and bridges represent nearly all of the nonagricultural losses. This estimate was $2.3 million. A few bridges were either severely damaged or destroyed. Most of the road damage occurred from washouts.

a. James River. Flooding on the James River, from its mouth upstream to Mitchell, South Dakota, caused major flood damage. Aerial photos showing the flooding are on plates 18 through 24. Plate 25 shows the high-water profile. Extensive channel degradation occurred near the mouth of the river in the form of headcutting. The degradation may have been aggravated by the low Missouri River stages that resulted from the reduced Gavins Point Reservoir releases which were cut to relieve flooding downstream. The resultant degradation forced the closing of one of the South Dakota Highway 50 bridges east of Yankton because of the undercutting of a bridge pier. Two houses between Highway 50 and the mouth of the river were evacuated because of bank erosion.

Field surveys conducted by Omaha District personnel estimated that approximately 27,100 acres of primarily agricultural land were inundated by floodwaters. This amounts to $6,292,000 in agricultural damages.

Mitchell was also subjected to flooding from Dry Run Creek. Approximately 24 homes and several businesses were affected. Some streets were washed out and some park facilities were damaged, at a repair cost of $24,000. The city engineer described the cause of the flooding problem as being at least partially attributable to a lack of storm sewers to handle the local runoff.

Flooding from Dry Run Creek also caused rural damages. According to the Civil Defense office for the area, public roads and bridges sustained $200,000 in damages, and 15,000 acres of agricultural land were inundated.

Two privately owned dams on minor James River tributaries failed, causing damage. Menno Lake Dam and Dimock Dam, both approximately 50 years old and less than 45 acres in size, failed because of the lack of proper maintenance, according to the Hutchinson County Civil Defense Director. Over the years the spillway of both dams had silted in. The Menno Lake Dam spillway was within 1-1/2 feet from the top of the dam. Failure initiated in the vicinity of the spillway. A farmstead approximately 1-1/2 miles downstream from the dam was flooded to a depth of 4 feet. Damage was estimated at $500,000 to $800,000. A hog-finishing building and numerous outbuildings were damaged. Three cars were severely damaged. The farmhouse was moved from its foundation and pushed up against a hillside. Because the family had evacuated, there were no injuries or loss of life. Approximately 110 to 115 acres of bottom land lost 2 to 2-1/2 feet of topsoil. A county road was also damaged. Dimock Dam failed in the same way; however, it took longer to drain and there were no real damages other than nuisance flooding.

Yankton, on the Missouri River upstream from the mouth of the James River, lost the embankments of two sewage treatment lagoons from flooding on Marne Creek, according to information furnished in the Interagency Flood Hazard Mitigation Report, FEMA-717-DR-SD.

b. Vermillion River. On the Vermillion River, major flooding occurred from the mouth upstream to the community of Davis, with Davis receiving only minor damage. It is estimated that approximately 29,600 acres were flooded, all of which were agricultural lands. The area inundated was determined by field surveys conducted by Omaha District personnel. Damages amounted to $4,736,000. Some farmers were able to replant whereas others were not able to get back into their fields at all. Those that replanted experienced an early frost with either a loss of their crop or a significant reduction in yield.

Within the city of Vermillion, there were damages to utilities--the wastewater treatment plant and storm and sanitary sewers--that were located along the north bank of the Vermillion River. The city engineer estimated damages at $160,000. A 6-inch waterline and a force main had to be replaced. One telephone pole and one power pole were also replaced. An 18-inch sewerline washed out on two occasions and a 42-inch storm sewer failed as a result of high flows and the resultant channel degradation. No damage to structures in Vermillion was reported other than to a feed and grain operation which had 2 feet of water in several of its grain bins and main tower. A city park along the river was completely inundated. A railroad bridge over a minor tributary failed because of undercutting by the Vermillion River. This bridge is on the main line of the South Dakota rail system which services the area between Sioux City, Iowa, and Aberdeen, South Dakota.

Aerial photos of the flooded areas in the Vermillion River basin are shown on plates 26 through 28. A high-water profile is shown on plate 29. Thirty-six requests for Corps assistance under Public Law 84-99 were received. Two requests for Section 14 assistance on the Vermillion River near Vermillion were also received.

c. Big Sioux River. The Big Sioux River in South Dakota and Iowa flooded from upstream from the Corps project in Sioux City to upstream from Brookings, South Dakota, where the river was 4.7 feet above flood stage. From the mouth of the Big Sioux River to the mouth of the Rock River, just upstream from Hawarden, Iowa, approximately 70,000 acres of primarily agricultural land were flooded. Production loss was estimated at $11,500,000 or more. This information was furnished by the Siouxland Interstate Metropolitan Planning Council (SIMPCO). Other damages include erosion loss to 1,700 acres and topsoil loss to 2,670 acres. Because of the wet conditions in the flood plain, at least 10,000 acres were inaccessible for planting.

In addition to agricultural land damages, SIMPCO also estimated road damages at $300,000 and bridge repair costs at $70,000. Damage to public facilities totaled approximately $110,000, and a Northern Natural Gas pipeline had to be protected from erosion at a cost of $6,000.

Several unincorporated areas and townships along the Big Sioux River reported damages totaling $108,200. This damage was primarily to public property and roads. The city of Sioux Falls only experienced nuisance flooding, mostly in low-lying areas, with no damage reported. There was some

interior flooding and pumps were used to transfer the water over the levees and into the river.

The diversion project constructed by the Corps in 1965 on the Big Sioux River at Sioux Falls worked as designed, but it was alleged by local residents to have caused increased flood stages upstream from the project. From Sioux Falls upstream to Brookings, extensive damage occurred to roads, bridges, cropland, and farmsteads. Between Sioux Falls and Baltic, most of the roads were closed to traffic because of washed-out areas. In Renner, 33 structures were damaged from flooding which occurred on both the Big Sioux River and Silver Creek. Minor flooding occurred in Dell Rapids, Trent, Baltic, and Flandreau. In Dell Rapids, flooding occurred to 11 residences and 2 city facilities. In Trent, 15 houses experienced minor flooding. Baltic incurred damages to its city park. Flandreau sustained damages to the city park and golf course. Fourteen structures in the city park, including seven residences, were flooded. The only dollar damage figure available is for Dell Rapids, where the city estimated damages to public property and park areas at $5,000. This figure includes damage to roadways, the loss of picnic tables, and cleanup costs.

Battle Creek, a right-bank Big Sioux tributary, caused major flooding to the Lake Campbell vicinity. The manager of the East Dakota Conservancy Sub-District reported that Battle Creek flows exceeded Big Sioux River flows at the mouth of Battle Creek on 22 June. Some of the highest damages sustained from Battle Creek flooding were to a commercial camping facility. No dollar damage figure is available.

Aerial photos of the flooding in the Big Sioux River basin are shown on plates 30 through 32. Plate 33 shows the high-water profile. Twenty-one requests for Corps assistance under Public Law 84-99 were received. In addition, three Section 14 requests for assistance were received--two in Plymouth County, Iowa, and one on Beaver Creek at Canton, South Dakota.

d. Little Sioux River. The Little Sioux River in Iowa caused only lowland flooding upstream from the existing Corps project in the lower reach of the river. Aerial photos of this flooding are shown on plates 34 through 36. Channel degradation in the upper reaches of the Little Sioux River project, on the West Fork and Wolf Creek tributaries, resulted in minor sloughing of the channel banks and several areas of the existing levee.

In the Little Sioux River basin, nine requests for assistance under Public Law 84-99 were received. One request for Section 14 assistance on the Maple River at Danbury, Iowa, was also received.

e. Other Minor Missouri River Tributaries. Two requests for Section 14 assistance on small tributaries of the Missouri River downstream from Gavins Point Dam were also received--one on Marne Creek at Yankton, South Dakota, and one on Elk Creek at Jackson, Nebraska. Two other small Missouri River tributaries downstream from Gavins Point Dam caused flood damages. Five bridges on Bow and Pearl Creeks were damaged. According to the Nebraska Soil Conservation Service, the estimated cost of the damage was $1 million. Thirty head of livestock were also reported lost in the flooding.

A list of the flood damages prevented by Omaha District projects in Fiscal Year 1984 is presented as exhibit C. The cumulative total of damages prevented is also shown.

IV. NORTH PLATTE RIVER

1. BASIN DESCRIPTION

The North Platte River rises in northern Colorado in the mountainous region known as North Park. It proceeds in a northerly direction on the east side of the Continental Divide, enters Wyoming west of Cheyenne, and continues in a northerly direction to the vicinity of Casper. There it turns east across the Great Plains and proceeds southeasterly into and across Nebraska. About 40 miles west of the Nebraska State line, it is joined by the Laramie River. At North Platte, Nebraska, it is joined by the South Platte River, forming the Platte River. The North Platte River basin drains approximately 32,000 square miles.

a. Runoff Characteristics and Precipitation. The flow of the North Platte River upstream from Casper, Wyoming, originates primarily in the mountain ranges as snowmelt runoff. Downstream from Casper, the flow is largely a result of rainfall, lower mountain elevation snowmelt runoff, or a combination of both. Annual precipitation in the lower elevations of the basin ranges from 14.2 inches upstream from Casper to 13.5 inches near the Nebraska-Wyoming State line. Annual precipitation in the mountains exceeds 40 inches in some areas.

b. Streamflow Forecasts. The cold temperatures and heavy snowstorms of April resulted in a record or near record snow-water content equivalent on 1 May and a significant rise in the streamflow forecast from 1 April to 1 May 1984. Table 4 contains the progressive change in the streamflow forecasts prepared by the Soil Conservation Service. The National Weather Service, Bureau of Reclamation, and Corps of Engineers prepared similar forecasts, all reflecting the progressive change.

2. WATER PROJECTS

Glendo Reservoir, located on the North Platte River approximately 4.5 miles southeast of Glendo, Wyoming, was constructed by the Bureau of Reclamation as a multiple-purpose natural resources development. The Glendo Unit is adjacent to and operates in conjunction with other units of the Pick-Sloan Missouri Basin Program and the Kendrick and North Platte projects. Principal dams and/or reservoirs in the North Platte basin upstream from Lake McConaughy are listed in table 5. Regulations for the use of the 271,900-acre-foot flood storage zone at Glendo Reservoir are prescribed by the Secretary of the Army under the authority of the Flood Control Act of 1944. The 1971 Field Working Agreement stipulates that the District Engineer will determine the releases when the Glendo pool is between elevations 4635.0 and 4653.0 feet mean sea level (m,s.l.), the flood storage zone.

3. 1984 FLOODING

a. Meteorology. Meteorological data concerning the spring 1984 flood conditions are described in Section III.

Table 4
Forecast of Most Probable Runoff[1/]
North Platte River Basin

Location	Forecast Period	1 January 1,000 AF	1 January % of Avg.	1 February 1,000 AF	1 February % of Avg.	1 March 1,000 AF	1 March % of Avg.	1 April 1,000 AF	1 April % of Avg.	1 May 1,000 AF	1 May % of Avg.
North Platte River near Northgate, CO	Apr-Sep	422	161	320	122	300	114	320	122	367	140
North Platte River near Sinclair, WY	Apr-Sep	1,000	141	873	123	781	110	890	125	1,000	141
Encampment River near Encampment, WY	Apr-Sep	--	--	194	124	175	112	193	124	220	141
Sweetwater River near Alcova, WY	Apr-Sep	77.4	105	69.9	95	69.9	95	74.4	101	134	182
Rock Creek near Arlington, WY	Apr-Sep	--	--	65	112	61	105	59	102	72	124
Deer Creek at Glenrock, WY	Mar-Jul	--	--	55	124	49	111	51	116	57	130
LaPrele Creek near Douglas, WY (upstream from Reservoir)	Apr-Jul	--	--	36	129	32	114	34	121	38	136
North Platte River near Glendo, WY	Apr-Sep	1,187	122	1,026	106	925	95	1,050	108	1,260	130
North Platte River downstream from Guernsey Reservoir, WY	Apr-Sep	1,236	123	1,068	107	963	96	1,092	109	1,312	131
Laramie River and Pioneer Canal near Woods, WY[2/]	Apr-Sep	202	153	172	130	156	118	156	118	182	138
Little Laramie River near Filmore, WY	Apr-Sep	--	--	72	111	61	94	64	98	80	120

1/Prepared by the Soil Conservation Service
2/Observed flow plus transbasin diversion from North Platte River basin to Cache la Poudre River basin in Colorado

Table 5
Principal Dams or Reservoirs, North Platte River Basin Upstream from Lake McConaughy

Dam or Reservoir	River	Project	Began Storage	Normal Max. Water Elev. (feet m.s.l.)	Total Capacity (acre-feet)	Outlet Capacity (c.f.s.)	Capacity by Water Rights (kW/c.f.s.)	Spillway Crest (ft. m.s.l.)	Spillway Capacity (c.f.s.)
Seminoe	N. Platte	Kendrick	Apr 1939	6357	1,017,279	3,260	45,000/1,990	6307	46,500
Kortes	N. Platte	PSMBP 1/	Jun 1950	1642	4,760	--	36,000/2,850	6142	50,000
Pathfinder	N. Platte	N. Platte	Apr 1909	5850.1	1,016,000	2,000	48,000/2,320 2/	5850.1	65,000
Alcova	N. Platte	Kendrick	Feb 1938	5500	184,208	--	36,000/3,800	5460	55,000
Gray Reef	N. Platte	PSMBP Glendo Unit	Apr 1961	5332	1,800	--	--	5312	20,000
LaPrele	LaPrele Ck.	Douglas Reservoirs Co.	1909	5490	20,000	--	--	--	--
Glendo	N. Platte	PSMBP Glendo Unit	Jul 1956	4650 3/	789,402	13,000	24,000/3,340	4653	10,335
Guernsey	N. Platte	N. Platte	Jun 1927	4420	45,612	--	4,800/1,100	4370 4405.5	52,000 25,000
Whalen Diversion	N. Platte	N. Platte	Feb 1909	4279	--	Interstate Canal = 2,100 c.f.s. Fort Laramie Canal = 1,500 c.f.s.			
Lake Hattie	Laramie	Laramie Wtr Co.	1908	--	68,500	--	--	--	--
Wheatland No. 2	Laramie	Wyo Development Co.	1878	--	98,934	--	--	--	--
Grayrocks Reservoir	Laramie	MBPP 4/	1979	4404	146,768	1,450	Coal fired	4404 4415	55,500 112,300
Lake Alice	Int. Canal	N. Platte	1912	4182	11,015	--	--	--	--
Lake Minatare	Int. Canal	N. Platte	1915	4125	62,200	435	--	--	--
Lake McConaughy	N. Platte	CNPPI 5/	Feb 1941	3270	1,948,000 6/	18,000	--	3271	54,000

1/ PSMBP - Pick-Sloan Missouri Basin Project
2/ Fremont Canyon Powerplant, PSMBP-Glendo Unit
3/ 1984 elevation restriction
4/ MBPP - Missouri Basin Power Project
5/ CNPPI - Central Nebraska Public Power and Irrigation District
6/ Normal maximum - 1,916,500 acre-feet

b. Description of Flooding. The major flooding in the basin occurred on the tributary streams and on the North Platte River upstream from Seminoe Reservoir. The high-water conditions experienced downstream from the North Platte reservoirs were prompted by two factors.

(1) The total system storage for the reservoirs on the North Platte River on 1 March 1984 was the highest carryover value since Glendo Reservoir was filled in 1959--2,305,000 acre-feet. (Some of this storage was vacated during March and April prior to the high runoff.)

(2) The average snow-water content for the 11 stations upstream from Seminoe Reservoir established a maximum 1 May record of 26.2 inches.

The high sustained flows through the Casper reach and downstream from Guernsey Reservoir, however, caused no significant damage. Complaints were received regarding basement flooding, channel erosion, pasture flooding, and adverse effects on recreation.

Exhibit B presents a description of the flood conditions of 1984 and shows how those conditions compare with the flood of record.

4. RESERVOIR REGULATION DURING 1984 FLOODING

To accommodate the fluctuation in flows from the Laramie River and the demand for irrigation deliveries, the releases from Glendo Reservoir were adjusted to provide downstream flood control. Adjustments in the releases from Glendo Reservoir were issued by the Omaha District to target flows passing the Wyoming-Nebraska State line gaging station as follows: 14 May - 7,500 c.f.s., 17 May - 8,000 c.f.s., 15 June - 7,500 c.f.s., 19 June - 7,000 c.f.s, and 22 June - 6,500 c.f.s.

The flood storage zone was occupied for 51 days. On 5 July, the responsibility for determining the release rates from Glendo Reservoir was returned to the Bureau of Reclamation. The elevation restriction imposed for Glendo Reservoir in December 1983 (elevation 4650 feet m.s.l.) reduced the available flood storage space to 80 percent and precluded the use of the spillway and surcharge storage zone. The reservoir storage and the inflow/outflow hydrograph for Glendo Reservoir are illustrated on plates 37 and 38. Total system storage for the seven Bureau of Reclamation reservoirs on the North Platte River versus releases from Guernsey Reservoir for the 1964-1984 period is shown on plate 39. As a system, the North Platte River reservoirs reduced the peak flow at the Nebraska-Wyoming State line by 18,430 c.f.s., as shown on plate 40.

5. ADVANCE MEASURES

Because of the high stages of the Missouri River tributaries after the spring flooding, the snowpack that remained in the eastern slopes, and the high pool elevations of the reservoirs in the North Platte River basin, the Governor of Nebraska requested that the Corps construct advance measures projects at Bridgeport, Scottsbluff, and North Platte.

Field investigations were performed and proposals developed for each site. After review of the proposed project for Bridgeport, the locals performed the necessary work themselves and brought their levee system up to the required specifications. The project developed for Scottsbluff was approved by the Office of the Chief of Engineers; however, the local assurances could not be obtained. Because the project lacked local support, it was not completed. The advance measures project for North Platte was approved, subject to imminent need. It was not constructed because the high-water conditions did not materialize.

A total of $9,175 was expended in the investigation and preparation of the advance measures project request in the State of Nebraska.

6. DAMAGES

No significant damage was reported in the North Platte River basin.

V. PLATTE AND ELKHORN RIVERS AND SALT AND BIG PAPILLION CREEKS

1. BASIN DESCRIPTION

a. Topography. The eastern portion of Nebraska is dominated by rolling hills. These hills are thick deposits of windblown silt and clay called loess which rest on undulating glacial deposits. The upper portion of the Elkhorn River basin is typified by dissected plains. Throughout this area, layers of loess were deposited on a flatter surface to form a vast plain. Over time, much of the flat topography has been eroded by runoff to form hills and valleys.

b. Climate. The weather in the eastern portion of Nebraska is variable, which is typical of the interior of a large land mass in middle latitudes. Rapid weather changes are caused by invasions of large masses of warm, moist air from the Gulf of Mexico; hot, dry air from the southwest; cool, dry air from the Pacific Ocean; and cold, dry air from Canada.

c. Precipitation. The average annual precipitation in the eastern third of Nebraska is about 27 inches. On the average, nearly 80 percent of the yearly total falls in the 6 months from April to September. During July and August, rainfall normally diminishes slowly, but localized flooding can be expected on smaller streams because of short-duration, high-intensity rainfall.

2. WATER PROJECTS

The Corps, the Natural Resources Districts, the Soil Conservation Service, and private interests have constructed numerous levees and floodwater retaining structures and improved channel areas throughout the Elkhorn River, lower Platte River, and Papillion Creek basins. The Corps has completed 10 dams as part of the Salt Creek flood control project and 3 dams in the Papillion Creek basin.

Salt Creek, a tributary to the Platte River, is located in southwestern Nebraska and has a drainage area of 1,645 square miles. The 10 reservoirs which form the Salt Creek and tributaries project provide control to the 215 square miles upstream from the city of Lincoln, the major center of potential urban flood damage. A summary of engineering data concerning the 10 Salt Creek dams is included on plate 41.

The dams and lakes of the Salt Creek project were designed for unattended operation during the time when the pool elevations are within the flood storage zones.

3. 1984 FLOODING

a. Meteorology. Meteorological data on the 1984 spring flooding are presented in Section III. Rainfall isohyetal maps of the storms over the Salt Creek basin on 12-13 June, over the Papillion Creek basin on 14 June,

and over the Pebble Creek basin in east-central Nebraska on 15-16 June are shown on plates 42, 43, and 44, respectively.

b. Description of Flooding. A combination of saturated soil conditions and above average precipitation in May and June maintained all of the Salt Creek reservoirs in the flood storage zones during the April through August period. Pool elevation plots for the Salt Creek reservoirs, as generated by the data collection platforms, are shown on plates 45 through 54. The intense thunderstorms on 12-13 June 1984, which produced 5 inches of rainfall in the Salt Creek basin, established two pools of record, repeated the record pool established in 1973 at Dam No. 2, and caused record stages downstream from Lincoln to the mouth. The record pool elevations are presented in table 6.

Table 6
Record Pool Elevations - 13 June 1984
Salt Creek Basin

Salt Creek Project	Elevation (feet m.s.l.)
Olive Creek (Dam No. 2)	1342.6
Pawnee Lake (Dam No. 14)	1247.2
Holmes Park Lake (Dam No. 17)	1249.9

Aerial photographs of the record pools are shown as figures 9, 10, and 11. The recreation areas and marina at Holmes Park Lake were extensively damaged by the high water. Other Salt Creek recreation areas that were closed because of high water included boat ramps and campgrounds at Wagon Train, Stagecoach, Bluestem, and Olive Creek Lakes. Minor flooding also occurred at other areas within the basin. A high-water profile for Salt Creek is shown on plate 55. Two fatalities were recorded in the city of Lincoln as a result of flooding on Stevens Creek, a right-bank tributary to Salt Creek.

The combined Salt Creek reservoirs and associated levees and channel improvements were effective in reducing flood damages in Lincoln. The high water that occurred at Greenwood, shown on plate 56, and Ashland was induced by the extensive rainfall that occurred downstream from the Salt Creek project. The rainfall on 11-12 June left the city of Ashland surrounded by water with only one road access to the community. The National Guard camp near Ashland flooded and the State of Nebraska asked for assistance from the Corps to cope with channel bank erosion and flood problems at the camp. Photos of the flooding in the Ashland area are shown as figures 12 and 13.

Serious flooding occurred downstream from the confluence of the Platte River with Salt Creek to the Missouri River and caused record flows. Minor flooding occurred in areas upstream from the Platte River's confluence with Salt Creek. A high-water profile for the Platte River from its confluence with Salt Creek to its confluence with the Missouri River is shown on plate 57.

Figure 9. View of Salt Creek Dam No. 2 - Olive Creek, 13 June 1984. (Pool Elevation - 1342.63 feet m.s.l.)

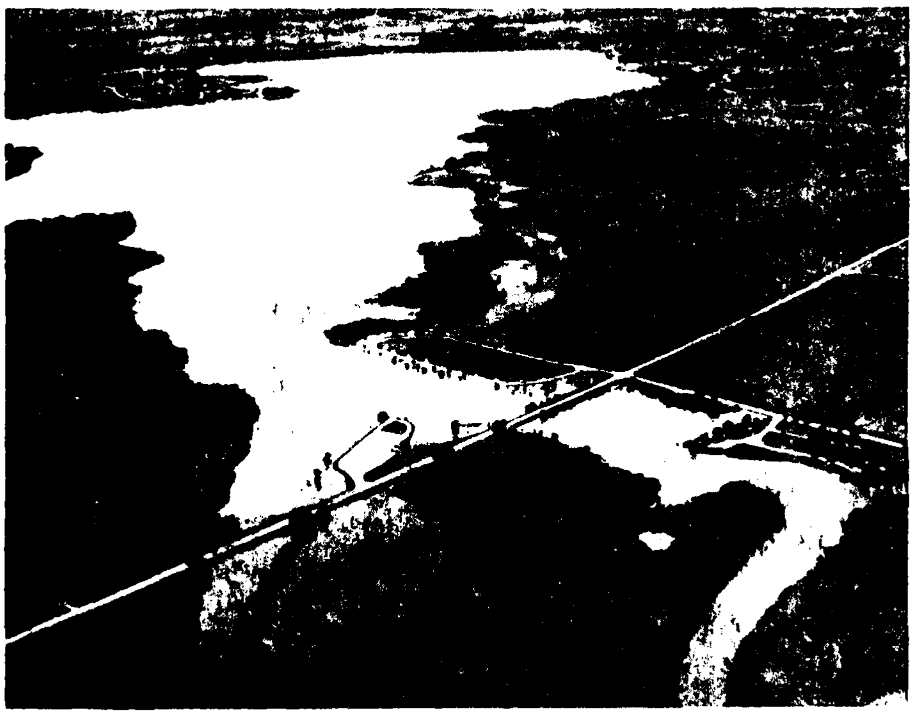


Figure 10. View of Salt Creek Dam No. 14 - Pawnee Lake, 13 June 1984. (Pool Elevation - 1246.8 feet m.s.l.)

Figure 11. View of Salt Creek Dam No. 17 - Holmes Park Lake, 13 June 1984. (Pool Elevation - 1245.9 feet m.s.l.)

Figure 12. View of collapsed bridge on Highway 6 near Ashland, Nebraska, caused by flooding from Salt Creek, 14 June 1984. (At Greenwood, Nebraska: Discharge - 15,000 c.f.s., Gage Height - 16.34 feet)

Figure 13. View of flooding in Ashland, Nebraska, caused by high flows on Salt Creek, 13 June 1984. (At Greenwood, Nebraska: Discharge - 48,000 c.f.s., Gage Height - 26.70 feet)

Serious flooding was experienced along the Elkhorn River, a tributary to the Platte River, from its mouth upstream to Stanton. A high-water profile for that reach of the Elkhorn River is shown on plate 58. Areas along almost all of the Elkhorn River tributaries also experienced considerable flooding. They include Maple Creek, Pebble Creek, and Bell Creek. Record flows on Pebble Creek, a right-bank tributary to the Elkhorn River, combined with high water on the Elkhorn River at West Point, shown on plate 59, and caused considerable damage to the Scribner area. Plate 60 presents a map showing the location of surveyed high-water marks along that reach of the Platte River.

High flows on the Platte River at Grand Island, shown on plate 61, joined with the high discharges from the Salt Creek and Elkhorn River basins and incremental drainages to produce a record discharge of 144,000 c.f.s. at the Louisville gaging station, as shown on plates 62 and 63.

In the Big Papillion Creek basin in Omaha, flooding affected a park, three golf courses, and a few homes. A high-water profile for Big Papillion Creek is shown on plate 64.

Data on flood conditions are presented in exhibit B. The data show how the stages and peak discharges of the flood of record for the Big Papillion and Salt Creeks and the Platte and Elkhorn Rivers compare with the 1984 flooding.

4. DAMAGES

The Nebraska State Soil Conservation Service reported that flooding on Salt Creek caused some rural damages in Lancaster County. Damages to gravel roads, nine culverts, and two bridges amounted to $62,000, $22,500, and $72,000, respectively. Two head of livestock were also lost.

On 12 June, flooding on a tributary to Salt Creek attributed to the deaths of two people in Lincoln. One of the Salt Creek projects near Lincoln--Holmes Park Lake--sustained approximately $5,000 in damage to the park facilities and marina. Total damages from flooding along Salt Creek were estimated at $1,703,000 in the reach downstream from Lincoln to the mouth.

The town of Ashland was flooded on 13 June from high flows on Salt Creek. There were 28 single-family homes that sustained major damage, 5 single-family homes that sustained minor damage, and 24 mobile homes that were destroyed. Three business were also destroyed. Damage to private structures in Ashland amounted to $995,000. Damage to public facilities was $130,000. This information was obtained from the Nebraska Civil Defense Office. The National Guard camp near Ashland also flooded and was threatened by erosion. Damage to the structures and contents in the amount of $36,000 occurred.

According to the Nebraska Soil Conservation Service, flows on Wahoo Creek, a tributary to Salt Creek, caused $135,000 in damage to roads, $45,000 in damage to three bridges, and $5,000 in damage to farmsteads. The Wahoo Creek flows, estimated to be about a 10-year event, inundated 40 homes in Ashland. A 4-inch gasline over the Silver Street Bridge was damaged, and phone service was disrupted for 1 day.

The record flows on the Platte River downstream from the confluence of Salt Creek caused damage throughout the Louisville area. Most of the riverside cabins received major damage. According to the Louisville city clerk, approximately 12 homes experienced flood damage--mostly because of water in the basements and because of the mud and silt left after the water receded. At the Louisville State Recreation Area, the preliminary cost to repair damage was estimated at $83,600 by the Nebraska Game and Parks Commission. Half of the park area was flooded and 64 mature trees and 42 small trees were lost. Electrical outlets at camping sites were damaged, ground cover was lost, roads washed out, and the sewer lift station silted in. Additionally, the water wells had to be treated for contamination. The Platte River State Park and the Schramm State Recreation Area, just upstream from Louisville, also sustained flood damages. At the Platte River State Park, damage was mainly to the banks around the well fields which had eroded away. At the Schramm State Recreation Area, siltation was a problem. Also, some of the fish holding ponds were flooded.

In the Elkhorn River basin, there were approximately 140,000 acres of agricultural land flooded, according to the Elkhorn Natural Resources District. The estimated damage was $38,920,000.

High flows on Elkhorn River tributaries resulted in flooding along most of them. On the Middle Fork Maple Creek there were four bridges damaged, at a cost of $400,000. Approximately 8,000 acres of farmland were flooded, causing damages amounting to $2,224,000. Damages to roads and bridges amounted to $165,000 and $425,000, respectively. Minor flooding occurred in the town of Clarkson because of interior drainage, but the Corps levee and channel improvement project there prevented $342,000 in damages from high flows on the Middle Fork Maple Creek. Flooding from the East Fork Maple Creek occurred in Howells when a private levee broke. An estimated $1 million in damage occurred to recreation areas, cropland, and riverside developments. The town of Nickerson experienced $25,000 in damages from flooding on Maple Creek.

Flooding along Spring Creek, a small Elkhorn River tributary, resulted in damages estimated at $73,400, as reported by the Nebraska Soil Conservation Service. These damages were to bridge approaches, farmsteads, and a television station. Flooding along another tributary, Plum Creek, resulted in some damage to roads. Flooding on Logan Creek caused $75,000 in damage to roads and another $150,000 in damage to bridges.

Flooding along Bell Creek, a left-bank tributary to the Elkhorn River, caused $23,000 in damages to gravel roads and $248,000 in damages to four bridges. The city park in Craig had damages amounting to $10,000. Additionally, there were 2,000 acres of farmland flooded, which amounted to $556,000 in damages.

Flows from another Elkhorn River tributary, Pebble Creek, caused costly damage. Damages to farmsteads, roads, and bridges were estimated at $33,000, $150,000, and $275,000, respectively. Approximately 50 head of livestock were also lost because of the flooding. Additionally, the towns of Scribner

and Dodge had a combined damage estimate of $3.8 million. Scribner experienced flood depths of 3 to 4 feet, which inundated several businesses and homes. More than 100 homes had flooded basements. This was caused, to a great extent, by sewers backing up. Several incidents of basements caving in were reported. The city clerk's office, the fire station, and one residence had floodwaters on their first floor. There was also damage to the town's streets, fairgrounds, and swimming pool.

Flooding on the Elkhorn River itself caused $15,000 in damages to roads and public property. Downstream, the town of Winslow and the surrounding area had flood damages of $207,000. The Corps levee project at Hooper prevented $301,000 in damages from occurring in that town.

Flooding along the Big Papillion Creek caused damage to several homes in the Rainbow addition, three golf courses, baseball fields, and one indoor tennis/soccer club. According to the property owners, damages to the homes varied from $5,400 to $22,000, including cleanup costs. Some basements were flooded to a depth of 3-1/2 feet and others were flooded to the basement ceiling. Furnaces were repaired or replaced in some homes and many personal possessions were lost. The three golf courses had physical damages and a loss of income totaling $66,000, according to the grounds keepers. This amount includes cleanup costs. Areas of the golf courses had to be sodded and reseeded. Some baseball fields were damaged from the silt that remained on them after the floodwaters receded. The indoor tennis/soccer club had extensive damage to the floors and had flooding in the basement locker room. Some of the floors had to be replaced and there was a large cleanup effort. Damage estimates were not available from the facility.

Two railroads reported damage within the State of Nebraska. The Chicago and North Western Railroad and the Burlington Northern Railroad reported flood damages of $350,000 and $2 million, respectively. Damage occurred mainly to tracks and bridges.

The total expenditure for the flood fight in the State of Nebraska was $240,800, according to the Nebraska State Civil Defense Office. This includes costs for rescue, security, and State operation. The total cost could not be broken down by river basin.

Five requests were received for assistance along the Elkhorn River under Public Law 84-99. Several requests for Section 14 assistance were also received. Two were in the Salt Creek basin--one in Lincoln and one on Stevens Creek; two were on the Platte River--one at Brady and one at Hanson Lake; and one was in the Elkhorn River basin on Redbird Creek in Holt County.

Exhibit C presents the amount of flood damages prevented by Omaha District projects both in Fiscal Year 1984 and cumulatively. The damages prevented by the Salt Creek project and other projects in the Platte River basin are shown.

VI. NISHNABOTNA RIVER

1. BASIN DESCRIPTION

The Nishnabotna River basin encompasses 2,806 square miles upstream from Hamburg, Iowa. Located in the southwestern portion of the State, the basin is marked by rolling agricultural land. Average annual precipitation is approximately 31 inches.

2. WATER PROJECTS

The Corps of Engineers constructed levees near Red Oak and Hamburg and placed riprap under Section 14 authority to provide bank protection near Hancock, Hastings, Essex, Malvern, and Griswold. In addition, there are numerous small agricultural dams or check structures designed by the Soil Conservation Service.

3. 1984 FLOODING

Two independent events occurred in the Nishnabotna River basin during the spring of 1984. The first event was reported on the East Nishnabotna River at Atlantic on 30 April. Four inches of rain that occurred from 27 through 30 April combined with existing saturated soil conditions to produce a peak gage height of 14.22 feet, as shown on plate 65. The major storms over the West Nishnabotna River occurred in mid-June. Approximately 3.5 inches of rain fell near Hancock in a 1-week period and generated a peak stage of 10.28 feet on 15 June, as shown on plate 66. These storms, in combination with localized runoff, established a maximum gage height of record at 27.88 feet on 16 June upstream from Hamburg, as shown on plate 67. The previous gage height record, established in June 1947, resulted from a significantly higher discharge. The 1947 event, however, occurred prior to completion of the levee project.

4. DAMAGES

Farmland near the mouth of the Nishnabotna River in Missouri was flooded when water became trapped behind the existing levees. This situation has occurred for the last 3 years. Ten requests for assistance under Public Law 84-99 were received. One request for Section 14 assistance on the West Nishnabotna River at Manning, Iowa, was also received.

VII. MISSOURI RIVER
SIOUX CITY, IOWA, TO RULO, NEBRASKA

1. GENERAL

This section of the report covers the Missouri River main stem and its adjacent flood plain from Sioux City, Iowa, downstream to Rulo, Nebraska. Descriptions of some of the tributary basins that make up the Missouri River basin are provided in other sections of this report.

2. WATER PROJECTS

A major project downstream from the six main stem dams on the upper Missouri River is the Missouri River levee system. This system was authorized by the Flood Control Acts of 1941 and 1944 to include nearly 1,500 miles of levee from Sioux City to the mouth of the Missouri River. The portion of the levee system applicable to the Omaha District consists of a series of levee units and appurtenant works along both banks of the river from Sioux City to Rulo. The levee system was designed to operate in conjunction with the six main stem dams to provide protection for agricultural lands and small communities along the Missouri River. The following units of the levee system have been completed thus far: R-520, L-536, R-548, L-550-561, R-562, R-573, L-575, L-594, L-601, R-613, and L-624-627. Levee units L-611-614 and R-616 are currently being constructed. Levee units L-624-627 are an integral part of the Council Bluffs levee project, an urban protection project for the city of Council Bluffs. The city of Omaha is protected by a separate levee and floodwall system that was authorized by the Flood Control Act of 1944. It consists of 12.5 miles of earth levee and approximately 1 mile of concrete floodwall.

3. 1984 FLOODING

Flooding along the Missouri River from Sioux City, Iowa, to Rulo, Nebraska, was a result of heavy tributary inflow. There were two separate crests in 1984 on the Missouri River in this reach--one upstream and one downstream from the mouth of the Platte River. A large rainfall-producing storm occurred on 11 and 12 June and caused the Platte River and its tributaries in southeastern Nebraska and several tributaries in western Iowa to swell to overbank or bankfull conditions. This caused the Missouri River downstream from the mouth of the Platte River to rise and reach the 1984 crest level. The crest was 6 to 9.5 feet above flood stage in this reach. Stages were such that 6 to 14 feet of water was against the Federal levee system. A major flood fight took place on a private levee system known as the McCartney levee, which is located in Iowa just downstream from the confluence of the Platte River with the Missouri River. Releases from Gavins Point Dam were dropped to 12,000 c.f.s. to relieve the pressure on the levee systems. Stages on the Missouri River came within 1 foot of overtopping the Federal levee system near Brownville, Nebraska. Two emergency contracts were let for the rental of equipment and rock placement on the levee system. As State and county offices neared the exhaustion of their sandbag supply, they

requested sandbags from the Corps. The District provided the requested sandbags. Stages remained high and flooding, mostly from interior drainage, began to occur in Pacific Junction, Iowa. The State initiated a pumping operation at the site. Upon request from the State, the Omaha District rented two pumps to supplement the State's efforts. Approximately 1 week later, a series of storms and rainfall from 19 through 22 June occurred that swelled tributaries in northwestern Iowa, northeastern Nebraska, and southeastern South Dakota. This produced the 1984 Missouri River crest upstream from the mouth of the Platte River. (A more complete description of the meteorology is contained in Section III.) During both events, the river remained high, as shown on the plot of daily stages for Sioux City, Omaha, and Rulo for the April-July 1984 period shown on plate 68.

Plots of gage heights on the Missouri River that track the crest upstream from the mouth of the Platte River and the crest downstream from the mouth of the Platte River are shown on plates 69 and 70. Plate 71 illustrates the relationship of river velocity versus discharge. This particular plot represents the Missouri River at Nebraska City; the "S" shape of the curve is a result of the velocity decreasing after the river goes overbank and spreads out over the flood plain. As the gage height and discharge increase even more, the velocity once again increases. At this location, all of the water moved under the bridge. This is a reason for the measured velocities being higher than the crest velocity.

Aerial photos showing the extent of flooding on the main stem from Gavins Point Dam to downstream from Rulo are shown on plates 72 through 117. High-water profiles are shown on plates 118 and 119.

4. RESERVOIR REGULATION DURING 1984 FLOODING

Although the rainfall that produced the flooding along the Missouri River and its tributaries fell downstream from the six main stem dams, additional flooding was prevented by the regulation of the dams. As shown on plate 120, Gavins Point Reservoir releases were decreased in early June to alleviate flooding problems downstream from the mouth of the Platte River. After the storm that hit the area upstream from the mouth of the Platte River, Gavins Point Reservoir releases were reduced to 10,000 c.f.s. (less than one-third of normal) in an effort to reduce the flooding from Sioux City to Omaha. The total system storage for the six main stem dams increased by nearly 4 million acre-feet in the month of June. Had the main stem dams not been in place, the estimated peak gage height at Sioux City would have been 7.2 feet higher than that experienced. Figures 14 through 20 show the high water on the Missouri River near Omaha.

5. DAMAGES

The Federal levee system along the Missouri River was threatened by erosion in places because of chutes forming on the berms. On the Iowa side, emergency action was taken to save the levees. The cost to repair Levees L-594, L-550, and L-536 was $281,300. This amount includes costs for earthfill and riprap. Damage also occurred to numerous private levees

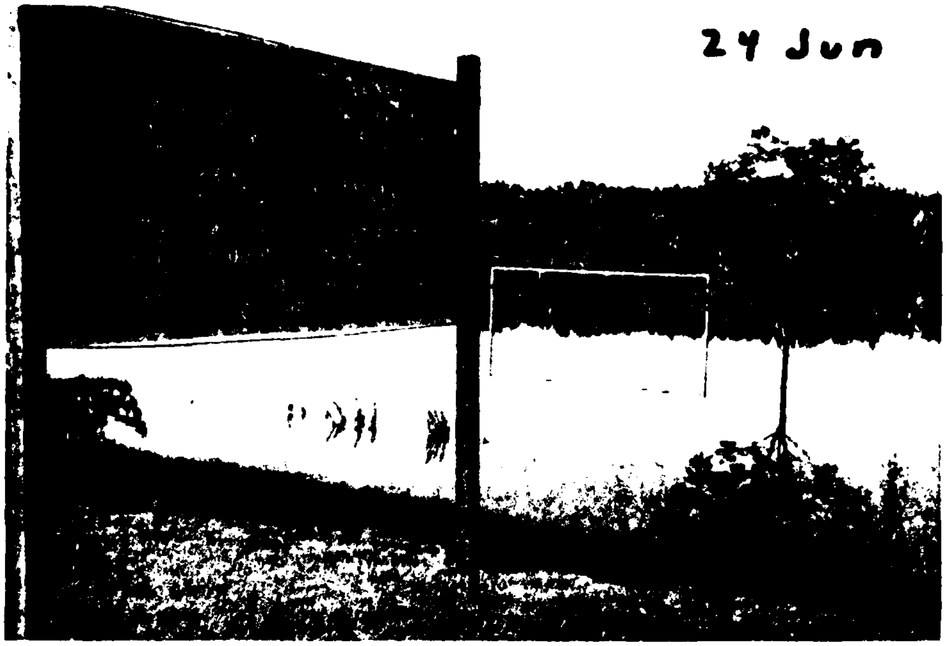


Figure 14. View of N. P. Dodge Park in Omaha, Nebraska, 24 June 1984. (Omaha Discharge - 107,000 c.f.s., Gage Height - 28.34 feet)

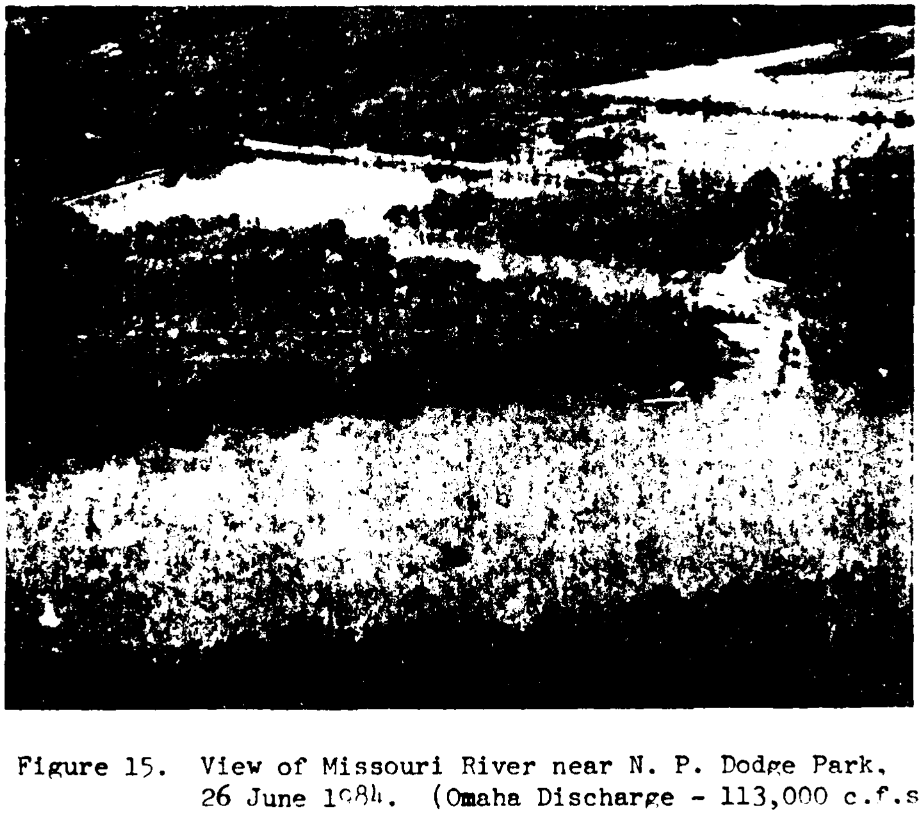


Figure 15. View of Missouri River near N. P. Dodge Park, 26 June 1984. (Omaha Discharge - 113,000 c.f.s., Gage Height - 28.65 feet)

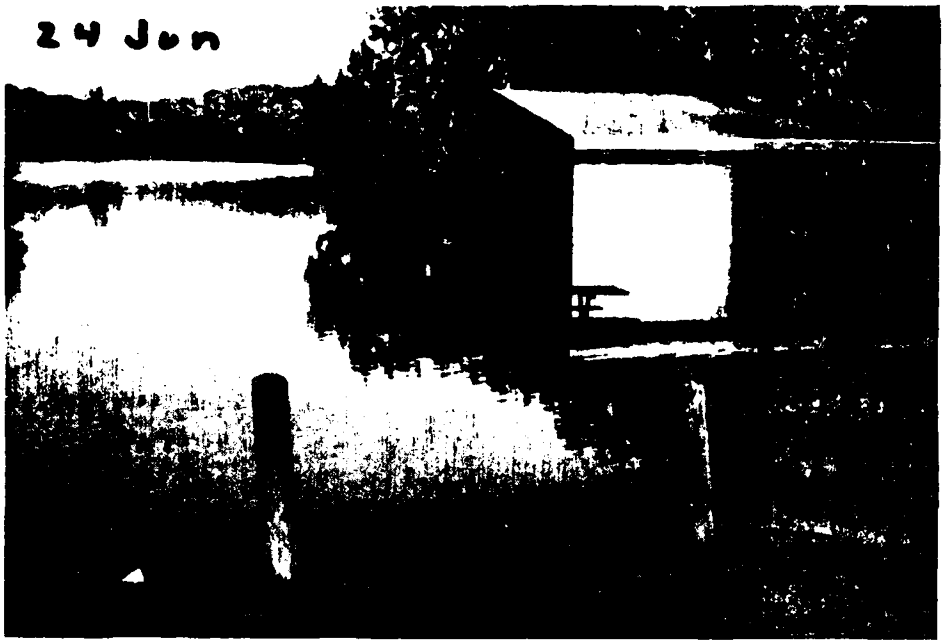


Figure 16. View of N. P. Dodge Park in Omaha, Nebraska, 24 June 1984. (Omaha Discharge - 107,000 c.f.s., Gage Height - 28.34 feet (8 inches below crest))

Figure 17. View of N. P. Dodge Park in Omaha, Nebraska, 24 June 1984. (Omaha Discharge - 107,000 c.f.s., Gage Height - 28.34 feet (8 inches below crest))

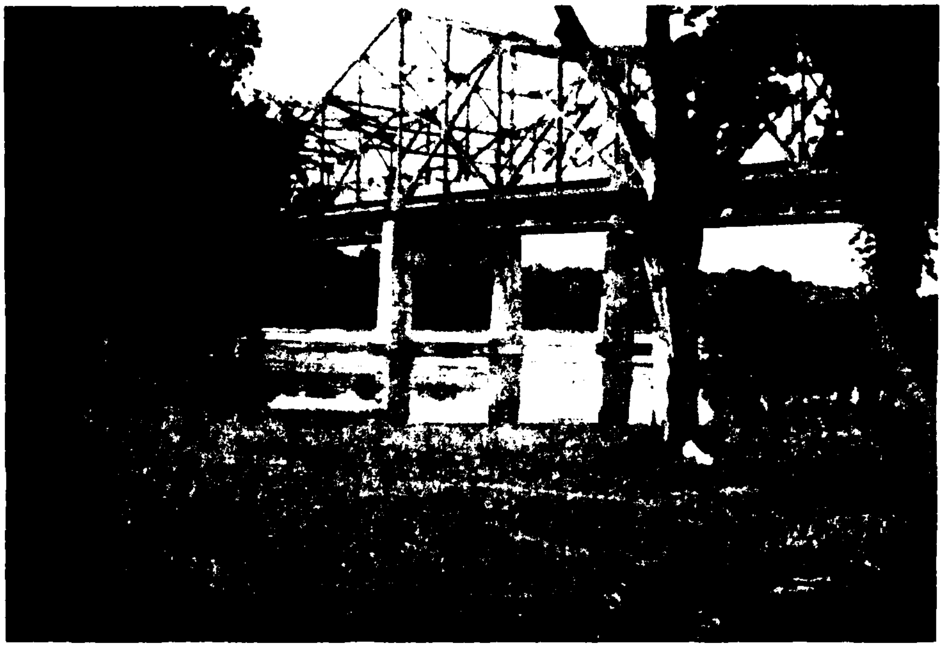


Figure 18. View of Interstate 680 - Mormon Bridge over the Missouri River in Omaha, Nebraska, 27 June 1984. (Omaha Crest: Discharge - 114,000 c.f.s., Gage Height - 29.03 feet)

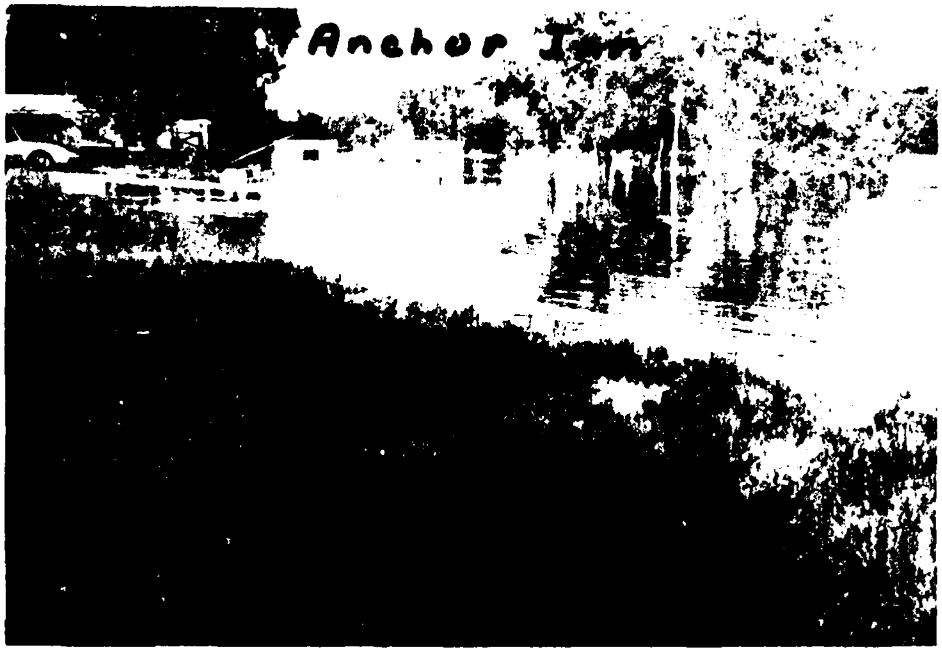


Figure 19. View of Anchor Inn in Omaha, Nebraska, 27 June 1984.

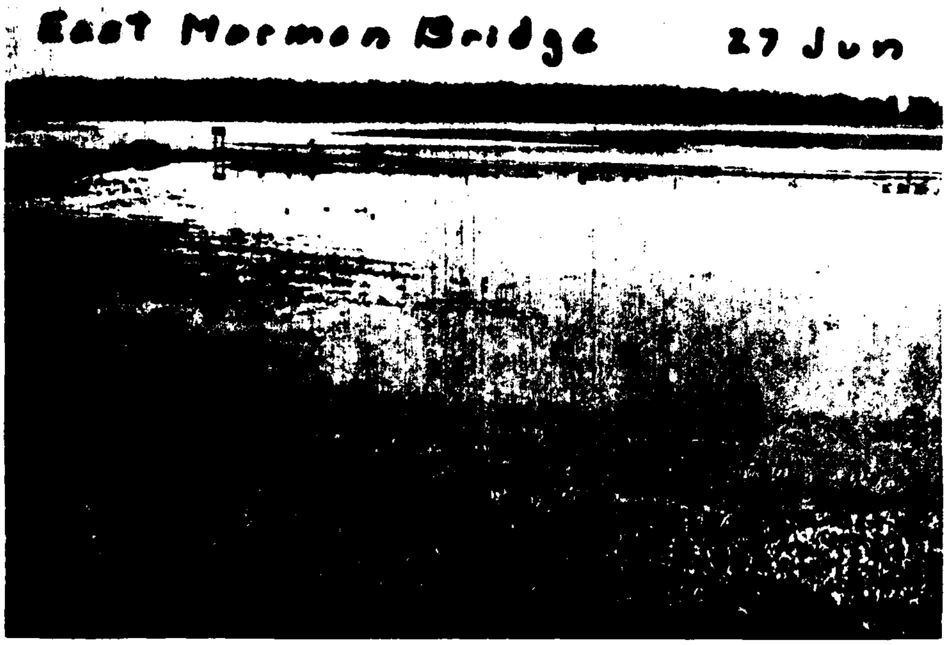


Figure 20. View of the east end of the Mormon Bridge, 27 June 1984.

however, no dollar figures are available at this time. The cost of the 42,000 sandbags the Corps provided for the protection of the levees was $21,000.

Flood damages amounting to $357,000 were sustained along the reach of the river between Sioux City and Decatur, Nebraska. In Decatur, one bridge across Elm Creek, a small right-bank tributary to the Missouri River, was lost and another threatened because of bank sloughing caused by the high water table and degraded condition. About a dozen homes in Decatur were also threatened. Flooding caused damage to recreation areas, riverfront developments, urban areas, and cropland.

In the reach of the river between Omaha and Rulo, 17,000 acres were flooded on the riverside of the levees. Damages totaled approximately $3,950,000.

The flood damages prevented by Omaha District projects in the reach of the Missouri River from Sioux City to Rulo are presented in exhibit C. In Mills County, Iowa, the benefits of the levee system were partly negated by water from interior drainage that got trapped behind the levees.

Thirty-six requests for assistance under Public Law 84-99 were received. One request for Section 14 assistance on Elm Creek at Decatur was also received.

High-Water Marks (HWM) on
Missouri River and Tributaries

James River

HWM No.	Elev.
J-1	1159.30
J-2	1170.96
J-3	1171.04
J-4	1179.23
J-5	1179.48
J-6	1180.88
J-7	1181.14
J-8	1185.61
J-9	1185.94
J-10	1188.38
J-11	1188.78
J-12	1192.05
J-13	1192.56

Vermillion River

HWM No.	Elev.
V-1	1139.82
V-2	1140.23
V-3	1147.53
V-4	1147.86
V-5	1148.71
V-6	1150.77
V-7	1152.20
V-8	1153.47
V-9	1157.15
V-10	1157.97
V-11	1167.17
V-12	1167.45
V-13	1175.19
V-14	1175.57
V-15	1182.21
V-16	1197.01
V-17	1198.74
V-18	1199.38
V-19	1200.16
V-20	1204.41
V-21	1205.68
V-22	1208.14
V-23	1208.49
V-24	1240.89
V-25	1241.35
V-26	1247.68
V-27	1249.05

Big Sioux

HWM No.	Elev.
BS-1	1090.41
BS-2	1092.07
BS-3	1093.55
BS-4	1096.54
BS-5	1098.29
BS-6	1098.49
BS-7	1105.72
BS-8	1109.60
BS-9	1109.71
BS-10	1110.33
BS-11	1116.68
BS-12	1123.57
BS-13	1123.82
BS-14	1141.39
BS-15	1150.31
BS-16	1158.99
BS-17	1170.00
BS-18	1183.26
BS-19	1183.25
BS-20	1195.80
BS-21	1195.83

Salt Creek

HWM No.	Elev.
S-1	1062.00
S-2	1071.69
S-3	1078.72
S-4	1078.56
S-5	1104.06
S-6	1114.73
S-7	1127.80
S-8	1132.58
S-9	1134.36
S-10	1135.26
S-11	1137.77
S-12	1138.20
S-13	1139.34
S-14	1139.08
S-15	1139.09
S-16	1138.69
S-17	1140.98
S-18	1141.75
S-19	1143.55
S-20	1145.28
S-21	1144.76
S-22	1147.92
S-23	1149.47

EXHIBIT A

Elkhorn River

HWM No.	Elev.
E-1	1124.85
E-2	1133.17
E-3	1138.15
E-4	1164.63
E-5	1192.68
E-6	1193.64
E-7	1208.15
E-8	1223.55
E-9	1224.02
E-10	1243.88
E-11	1249.83
E-12	1250.11
E-13	1270.96

Platte River

HWM No.	Elev.
P-1	968.36
P-2	971.99
P-3	972.86
P-4	990.54
P-5	992.20
P-6	997.92
P-7	1039.69
P-8	1049.08
P-9	1060.51
P-10	1073.98

Missouri River

HWM No.	Elev.
M-1	872.73
M-2	883.45
M-3	887.00
M-4	895.32
M-5	895.89
M-6	897.36
M-7	900.53
M-8	901.83
M-9	904.68
M-10	904.72
M-11	909.28
M-12	921.59
M-13	924.82
M-14	925.80
M-15	926.80
M-15a	930.22
M-16	931.04
M-17	935.48

Missouri River (Cont'd)

HWM No.	Elev.
M-18	935.86
M-19	938.50
M-20	943.30
M-21	948.92
M-22	953.05
M-23	955.90
M-24	959.97
M-25	960.19
M-26	963.15
M-27	965.55
M-28	966.78
M-29	969.40
M-30	971.30
M-31	974.40
M-32	976.00
M-33	980.18
M-34	984.26
M-35	993.38
M-36	995.94
M-36a	1004.90
M-37	1009.78
M-38	1014.85
M-39	1023.42
M-40	1034.44
M-40a	1044.60
M-41	1051.79
M-42	1057.72
M-43	1066.97
M-44	1076.59
M-45	1082.65

May-June 1984 Flood Data - Omaha District
Selected Stream Gaging Sites

Stream	Station	Drainage Area (sq. miles)	Period of Record (years)	Maximum Previous Flood Known: Date	Maximum Previous Flood Known: Stage (feet)	Maximum Previous Flood Known: Discharge (c.f.s.)	Maximum Discharge May-June 1984: Date	Maximum Discharge May-June 1984: Stage (feet) 1/	Maximum Discharge May-June 1984: Discharge (c.f.s.)	Recurrence Interval (years) 2/
M&H Ditch	Nr. Turin, IA	900	45	19 Feb 1971	23.03 4/	19,900	18 Jun	24.79	13,400	6
Little Sioux R.	At Linn Grove, IA	1,548	15	29 Apr 1975	17.85	8,620	17 Jun	19.57-7.6	13,100	5
Little Sioux R.	Correctionville, IA	2,500	63	7 Apr 1965	25.86	29,800	18 Jun	23.28-3.3	20,400	12
Maple River	At Mapleton, IA	669	46	12 Sep 1978	16.74	20,800	8 Jun	15.50-3.5	14,900	8
Little Sioux R.	Nr. Turin, IA	3,526	45	19 Feb 1971	27.44	30,000	16 Jun	22.72	31,400	14
				21 Jun 1983	26.54	31,200				
Soldier River	At Pisgah, IA	407	44	12 Jun 1950	28.17	22,500	16 Jun	20.35	11,700	3
Boyer River	At Logan, IA	871	55	19 Feb 1971	22.65	25,000	15 Jun	14.63	8,700	1
Big Papillion Cr.	At Fort St., Omaha, NE	126	18	--	--	--	15 Jun	28.00-1.0	14,500	--
Papillion Cr.	At Fort Crook, NE	384	36	--	--	--	15 Jun	30.00	13,000	--
North Platte R.	Nr. Sinclair, WY	4,175	45	15 Jun 1957	9.72	14,500	26 May	10.82-0.5	15,160	33
				26 Jun 1983	9.86	13,140				
Medicine Bow R.	Nr. Hanna, WY	2,338	45	29 Mar 1943	5.23	6,590	5 May	4.70	2,950	5
				26 Apr 1983	6.09	4,980				
North Platte R.	At Alcova, WY	10,812	50	6,10,11 Jun 1905	11.50	13,400	8 Jun	7.06	8,940	28 6/ 13
North Platte R.	Nr. Glenrock, WY	13,538	25	14 May 1965	7.10	16,000	10 Jun	6.40	9,320	8
North Platte R.	At Orin, WY	14,888	33	15 May 1965	10.00	23,800	15 May	7.42	11,300	4 6/ 4
North Platte R.	Blw. Guernsey, WY	16,237	84	3 Jun 1908	11.50	30,000	3 Jul	8.56	11,500	40 6/ 22
North Platte R.	Blw. Whalen Dam, WY	16,425	75	26 Jun 1955	9.85	22,000	19 Jun	6.42	7,010	13 6/ 13
Laramie River	Nr. Lookout, WY	2,174	53	17 Jun 1957	6.41	3,340	29 May	--	2,900	11
Laramie River	Nr. Ft. Laramie, WY	4,564	28	10 May 1973	9.40	6,260	16 May	7.91-1.9	4,680	22
North Platte R.	At State Line	22,218	55	2 Jun 1929	7.04	17,900	14 Jun	6.35-1.4	8,840	17 6/ 14
North Platte R.	At Mitchell, NE	24,300	78	3 Jun 1909	6.45	27,500	29 May	7.80	8,770	13 6/ 4
North Platte R.	At Bridgeport, NE	25,300	77	26 Jun 1899	5.39	24,900	20 Jun	11.16-1.2	10,160	12 6/ 4
North Platte R.	At Lewellen, NE	28,600	44	4 Jun 1971	N/A	13,500	19 Jun	7.65	9,670	--
North Platte R.	At North Platte, NE	30,900	91	11 Jun 1909	N/A	29,600	22 Apr	6.33	6,290	2

May-June 1984 Flood Data - Omaha District
Selected Stream Gaging Sites

Stream	Station	Drainage Area (sq. miles)	Period of Record (years)	Maximum Previous Flood Known: Date	Stage (feet)	Discharge (c.f.s.)	Maximum Discharge May-June 1984: Date	Stage (feet) 1/	Discharge (c.f.s.)	Recurrence Interval (years) 2/
Red Rock River	Blw. Lima Res, MT	570	66	15 May 1933	6.40	2,500	16 May	4.60-3.5	1,150	13
Beaverhead River	At Barretts, MT	2,737	77	20 Jun 1908	6.10	3,720	22 Jun	5.06-1.1	3,000	110 3/ 40
Beaverhead River	Nr. Twin Bridges, MT	3,619	49	12 Jun 1944	6.76	3,130	24 Jun	7.86-2.7	2,050	62 3/ 22
Ruby River	Nr. Alder, MT	538	46	10 Jun 1970	5.62 4/	1,670	16 May	6.27	4,050	400
Big Hole River	Nr. Melrose, MT	2,475	61	14 Jun 1927	14.00	23,000	22 Jun	6.85-0.9	10,500	5
Madison River	Blw. Enis Lake, MT	2,186	46	12 Jun 1970	8.01 4/	9,550	21 Jun	6.85-2.5	6,250	5
Gallatin River	At Logan, MT	1,795	68	21 Jun 1899	6.25	9,840	16 May	8.12-0.6	7,070	6
Missouri River	At Toston, MT	14,669	49	6 Jun 1948	11.77	32,000	24 Jun	10.87-0.9	26,900	7
Missouri River	Nr. Ulm, MT	20,941	33	Jun 1953	17.00	35,000	28 Jun	12.76	22,000	3
Niobrara River	Nr. Verdel, NE	12,600	27	27 Mar 1960	10.10	39,000	14 Apr	5.54	8,200	2
Bazile Creek	Nr. Niobrara, NE	440	32	16 Jun 1957	19.96	68,600	20 Jun	6.85	2,130	2
Bow Creek	Nr. St. James, NE	304	7	19 Aug 1979	9.38	4,840	21 Jun	13.23	15,600	5
James River	At Huron, SD	16,800	45	13 Apr 1969	16.70	9,000	22 Jun	13.15	3,300	5
James River	Nr. Forrestburg, SD	18,600	34	9 Apr 1969	17.16	12,500	24 Jun	15.74	6,210	8
James River	Nr. Scotland, SD	21,550	56	3 Apr 1962	18.74	15,200	23 Jun	20.27-7.3	26,800	65
Beaver Creek	Nr. Yankton, SD	144	4	20 May 1982	11.11	1,110	- - - -	Discontinued	- - - -	3
Vermillion River	Nr. Wakonda (Vermillion)	1,680	39	8 Apr 1969	17.17	9,880	22 Jun	17.40-3.4	16,500 5/	52
Big Sioux River	Nr. Dell Rapids, SD	5,060	36	9 Apr 1969	16.47	41,300	21 Jun	15.00-4.0	16,200	12
Skunk Creek	At Sioux Falls, SD	570	36	17 Jun 1957	17.78	29,400	22 Jun	15.30	8,700	13
Big Sioux River	At Sioux Falls, SD	5,770	13	10 Apr 1969	27.45	40,700	20 Jun	25.40	21,900	28
Split Rock Creek	At Corson, MN	475	19	8 Apr 1969	15.00	17,800	22 Jun	13.97-5.7	10,200	11
Big Sioux River	At Akron, IA	9,030	56	9 Apr 1969	22.99	80,800	23 Jun	22.37-6.4	50,900	24
Perry Creek	At Sioux City, IA	65	45	9 Jul 1944	30.50	9,600	20 Jun	18.20-2.7	3,500	3
Floyd River	At Alton, IA	258	29	Jun 1953	N/A	45,500	13 Jun	16.59-4.6	5,000	4
Floyd River	At James, IA	886	49	8 Jun 1953	25.30	71,500	21 Jun	21.24	7,940	4
Omaha Creek	At Homer, NE	168	39	19 Feb 1971	26.47	18,100	--	--	--	--

EXHIBIT B

May-June 1984 Flood Data - Omaha District
Selected Stream Gaging Sites

Stream	Station	Drainage Area (sq. miles)	Period of Record (years)	Maximum Previous Flood Known: Date	Maximum Previous Flood Known: Stage (feet)	Maximum Previous Flood Known: Discharge (c.f.s.)	Maximum Discharge May-June 1984: Date	Maximum Discharge May-June 1984: Stage (feet) 1/	Maximum Discharge May-June 1984: Discharge (c.f.s.)	Recurrence Interval (years) 2/
Platte River	At Brady, NE	56,200	48	29 Jun 1983	--	22,960	21 May	--	12,100	10
Platte River	Nr. Grand Island, NE	58,800	51	6 Jun 1935	5.99	30,000	19 May	5.16-1.2	16,100	9
Middle Loup R.	At St. Paul, NE	8,090	77	23 Jun 1947	12.69	72,000	12 Jun	6.40	29,500	25
North Loup R.	Nr. St. Paul, NE	4,290	60	6 Jun 1896	14.90	90,000	21 Apr	4.80	3,660	1
Platte River	At North Bend, NE	77,100	35	29 Mar 1960	10.04	112,000	13 Jun	9.14-1.1	65,600	11
Elkhorn River	At Norfolk, NE	2,790	52	14 Jun 1967	8.52	16,900	13 Jun	6.05	8,200	5
N. Fork Elkhorn R.	Nr. Pierce, NE	700	24	19 Feb 1971	15.10	15,200	1 May	12.36-0.4	1,580	2
Elkhorn River	At West Point, NE	5,100	24	25 Jun 1969	13.21	33,000	18 Jun	12.80-0.8	30,000	9
Pebble Creek	At Scribner, NE	204	6	9 Oct 1982	23.33	7,380	16 Jun	23.75-10.8	20,300 7/	7
Logan Creek	At Pender, NE	731	19	19 Feb 1971	23.11	36,900	16 Jun	16.80	12,500	3
Logan Creek	Nr. Uehling, NE	1,030	43	5 Jun 1940	20.60	2[illegible],200	17 Jun	17.80-1.8	10,500	4
				20 Feb 1971	20.15	25,200				
Maple Creek	Nr. Nickerson, NE	450	33	11 Jun 1944	16.28	35,000	17 Jun	17.86-2.9	5,900	7
Elkhorn River	At Waterloo, NE	6,900	64	12 Jun 1944	16.60 4/	100,000	18 Jun	18.12-1.1	42,650	17
Salt Creek	At Roca, NE	167	33	8 May 1950	26.00	67,000	13 Jun	20.77-1.8	6,420	6 8/ 5
Salt Creek	At Lincoln, NE	684	35	2 Jun 1951	26.15	28,200	13 Jun	21.00	15,500	4
Little Salt Cr.	Nr. Lincoln, NE	44	15	15 Jun 1982	15.80	6,520	12 Jun	16.17	7,500	17
Stevens Creek	Nr. Lincoln, NE	48	16	15 Jun 1982	18.85	3,820	13 Jun	19.57-5.6	4,600	7
Salt Creek	At Greenwood, NE	1,051	32	24 Jun 1963	23.46	41,000	13 Jun	26.70-6.7	48,000	10 8/ 10
Platte River	At Louisville, NE	85,800	31	30 Mar 1960	12.45	124,000	14 Jun	11.34-2.3	144,000	29 8/ 25
Weeping Water Cr.	At Union, NE	241	34	9 May 1950	29.80	60,300	13 Jun	29.67-7.7	55,000	52
Nishnabotna R.	Abv. Hamburg, IA	2,806	57	--	--	--	16 Jun	27.88	24,000	—
Little Nemaha R.	At Auburn, NE	793	35	9 May 1950	27.65	164,000	13 Jun	23.65-1.7	25,500	3

May-June 1984 Flood Data - Omaha District
Selected Stream Gaging Sites

Stream	Station	Drainage Area (sq. miles)	Period of Record (years)	Maximum Previous Flood Known: Date	Stage (feet)	Discharge (c.f.s.)	Maximum Discharge May-June 1984: Date	Stage (feet) 1/	Discharge (c.f.s.)	2/	Recurrence Interval (years) 9/	10/	11/
Missouri River	At Sioux City, IA	314,600	87	14 Apr 1952	24.28 4/	441,000	25 Jun	30.90	104,000	4	20	36	50
Missouri River	At Decatur, NE	--	--	--	--	--	26 Jun	34.6	--	--	--	--	--
Missouri River	At Blair, NE	--	--	--	--	--	27 Jun	17.3	--	--	--	--	--
Missouri River	At Omaha, NE	322,800	56	18 Apr 1952	30.20 4/	396,000	27 Jun	29.03	114,000	4	14	25	7
Missouri River	At Plattsmouth, NE	--	--	--	--	--	14 Jun	24.60-8.6	--	--	--	--	--
Missouri River	At Nebraska City, NE	410,000	55	19 Apr 1952	27.66	414,000	14 Jun	24.82-6.8	182,000	10	17	21	25
Missouri River	At Brownville, NE	--	--	--	--	--	15 Jun	41.4	--	--	--	--	--
Missouri River	At Rulo, NE	414,900	35	22 Apr 1952	25.60	358,000	16 Jun	24.48-7.5	242,000	18	--	48	100

1/Figures in this column are feet above flood stage
2/Event Frequency - Based on historical record
3/Future Recurrence Interval - Based on period since Clark Canyon Reservoir fill (1965 to present)
4/Site and datum then in use
5/Gage at Wakonda was discontinued in 1983. In 1984, gage was moved to Vermillion. Discharge of 16,500 c.f.s. was estimated from 20,200 c.f.s. at Vermillion on 22 June with gage height = 29.51 feet
6/Future Recurrence Interval - Based on period since effect of upstream dams (at Alcova - 1948 to present; downstream from Guernsey - 1960 to present)
7/Channel change
8/Future Recurrence Interval - Based on period since effect of upstream dams (1968 to present)
9/Recurrence Interval - Based on post Fort Randall period (1953 to present)
10/Future Recurrence Interval - Based on period since main stem fill (1967 to present)
11/Recurrence Interval - Based on M.B.S.A. May 1983 Final Flood Plain Study

Damages Prevented by Omaha District Projects

Omaha District Projects	Flood Damages Prevented FY 1984	Flood Damages Prevented Cumulative Total
Missouri River Reservoirs	$97,117,000	$690,988,000
Agricultural Levees L-601	$13,575,000	$ 46,893,000
L-594	9,599,000	33,430,000
L-575	8,037,000	61,258,000
L-561/L-550	6,831,000	50,184,000
L-536	1,914,000	13,869,000
R-613	2,982,000	10,139,000
R-573	344,000	2,565,000
R-562	1,033,000	7,763,000
R-548	765,000	5,546,000
R-520	230,000	1,629,000
Subtotal Levees	$45,310,000	$233,276,000
Flood Control Projects:		
Aurora, CO (Kelly Road Dam)	$ 0	$ 391,000
Bear Creek Dam, CO	0	450,000
Belle Fourche, SD	0	380,000
Blackbird Creek, NE	173,000	269,000
Bowman-Haley, ND	0	1,838,000
Broken Bow, NE	108,000	108,000
Chatfield, CO	0	1,880,000
Cottonwood Springs, SD	0	0
Cherry Creek Dam, CO	0	163,256,000
Clarkson, NE	342,000	407,000
Coldbrook Dam, CO	0	0
Columbus, NE	533,000	1,709,000
Council Bluffs, IA	43,484,000	295,205,000 1/
Floyd River, Sioux City, IA	0	26,755,000
Forsyth, MT	0	1,814,000
Gering, NE	0	210,000
Glasgow, MT	0	1,326,000
Greybull, WY	0	4,005,000
Hamburg, IA	7,072,000	25,850,000
Havre, MT	0	20,664,000
Hawarden, IA	0	433,000
Herreid, SD	0	33,000
Hooper, NE	301,000	541,000
Hot Springs, SD	0	0
Ida Grove, IA	0	180,000
Kenslers Bend, SD and NE	914,000	27,140,000 2/
Little Papillion, NE	0	0

EXHIBIT C

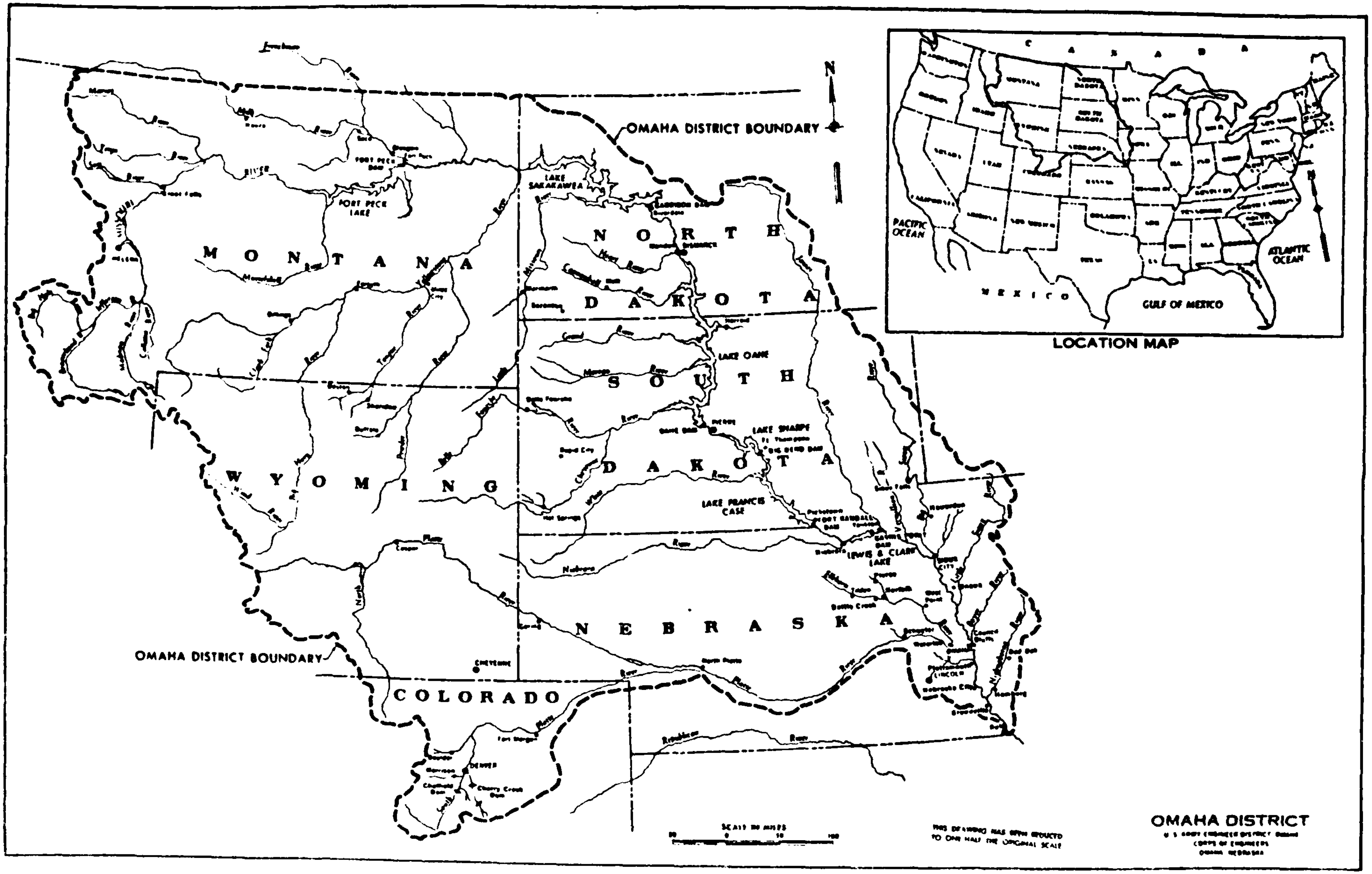
Damages Prevented by Omaha District Projects (Cont'd)

Omaha District Projects	Flood Damages Prevented FY 1984	Flood Damages Prevented Cumulative Total
Flood Control Projects (Cont'd):		
Little Sioux River, IA	$ 38,647,000	$ 101,795,000
Madison, NE	0	100,000
Mandan, ND	0	19,025,000
Marmarth, ND	0	1,449,000
McCook Lake, SD	0	0 3/
Meadow Grove, NE	32,000	49,000
Norfolk, NE	937,000	3,005,000
Omaha, NE	36,382,000	252,617,000
Papillion Creek Lakes, NE	0	0
Pierce, NE	0	450,000
Pipestem, ND	0	12,601,000
Platte River at Schuyler, NE	510,000	665,000
Red Dale Gulch, SD	0	250,000
Red Oak, IA	782,000	5,143,000
Saco, MT	0	728,000
Salt Creek, NE	26,757,000	40,272,000
Schuyler, NE	0	309,000
Scranton, NE	0	0
Sheridan, WY	0	741,000
Shields River, Clyde Park, MT	0	156,000
Sioux Falls, SD	589,000	16,522,000
Vaughn, MT	0	485,000
Waterloo, NE	0	470,000
West Glendive, MT	0	387,000
West Point, NE	86,000	2,689,000
Subtotal Flood Control Projects	$157,649,000	$1,034,782,000
Total	$300,076,000	$1,959,046,000

1/ Includes Missouri River Levees L-627 and L-624.

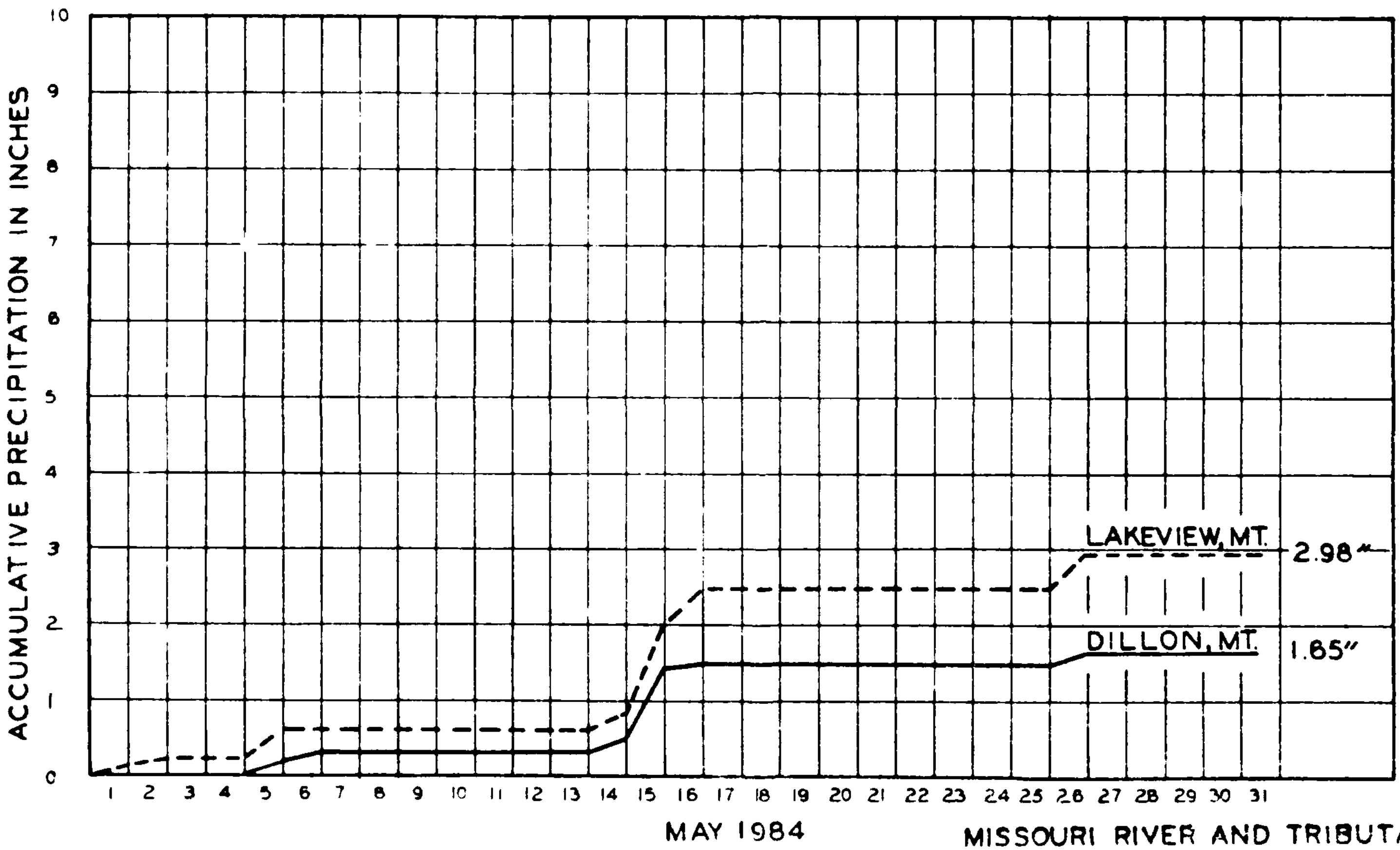
2/ Based on estimates of annual benefits. Projects serve other flood control purposes.

3/ $301,000 recreation benefits cumulative at the rate of $11,000 annually.



MISSOURI RIVER AND TRIBUTARIES
POST-FLOOD REPORT
SPRING FLOODS 1984
BASIN MAP

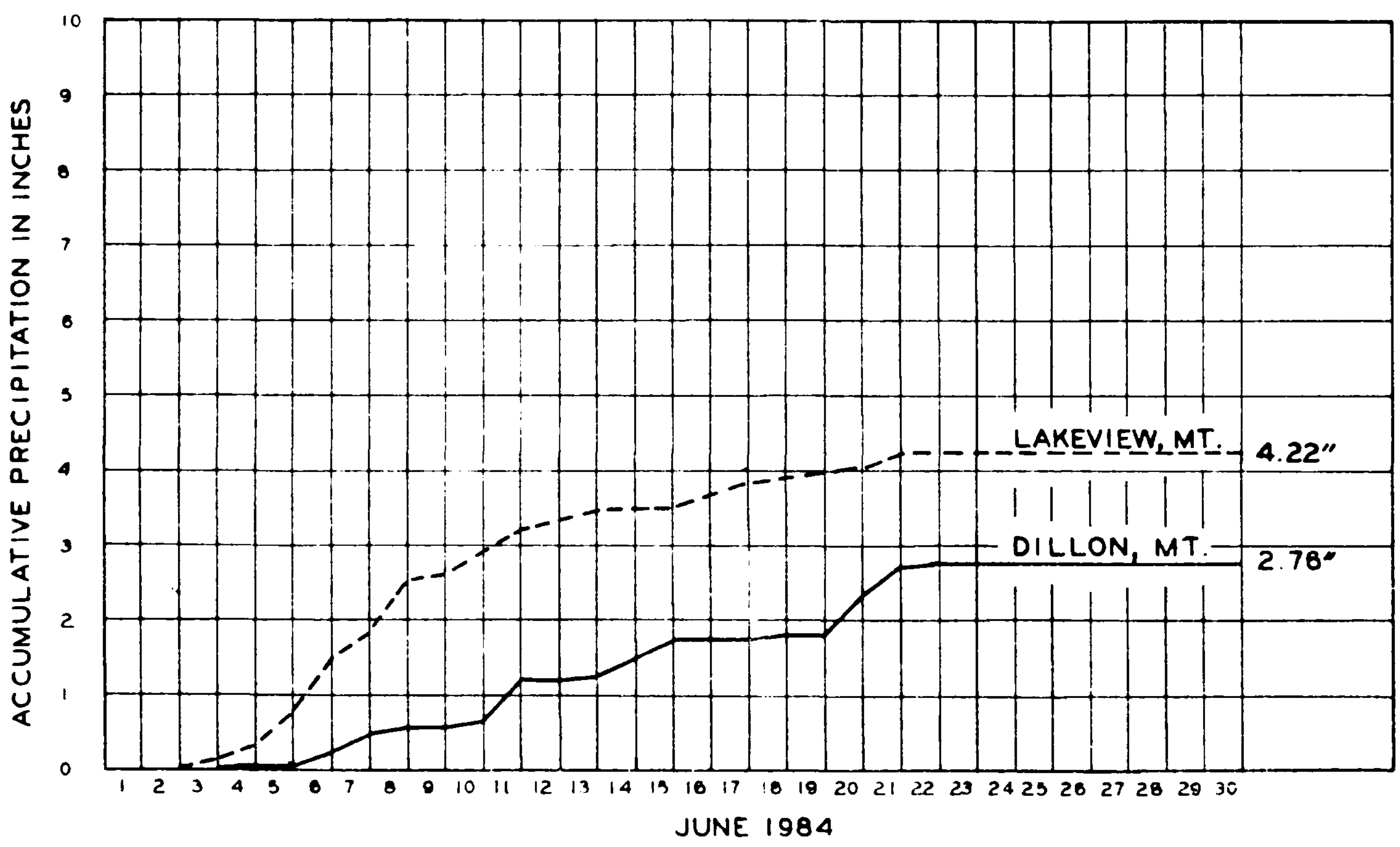
PLATE 1



MISSOURI RIVER AND TRIBUTARIES
POST-FLOOD REPORT
SPRING FLOODS 1984
REPRESENTATIVE
MASS RAINFALL CURVES
MONTANA - MAY 1984

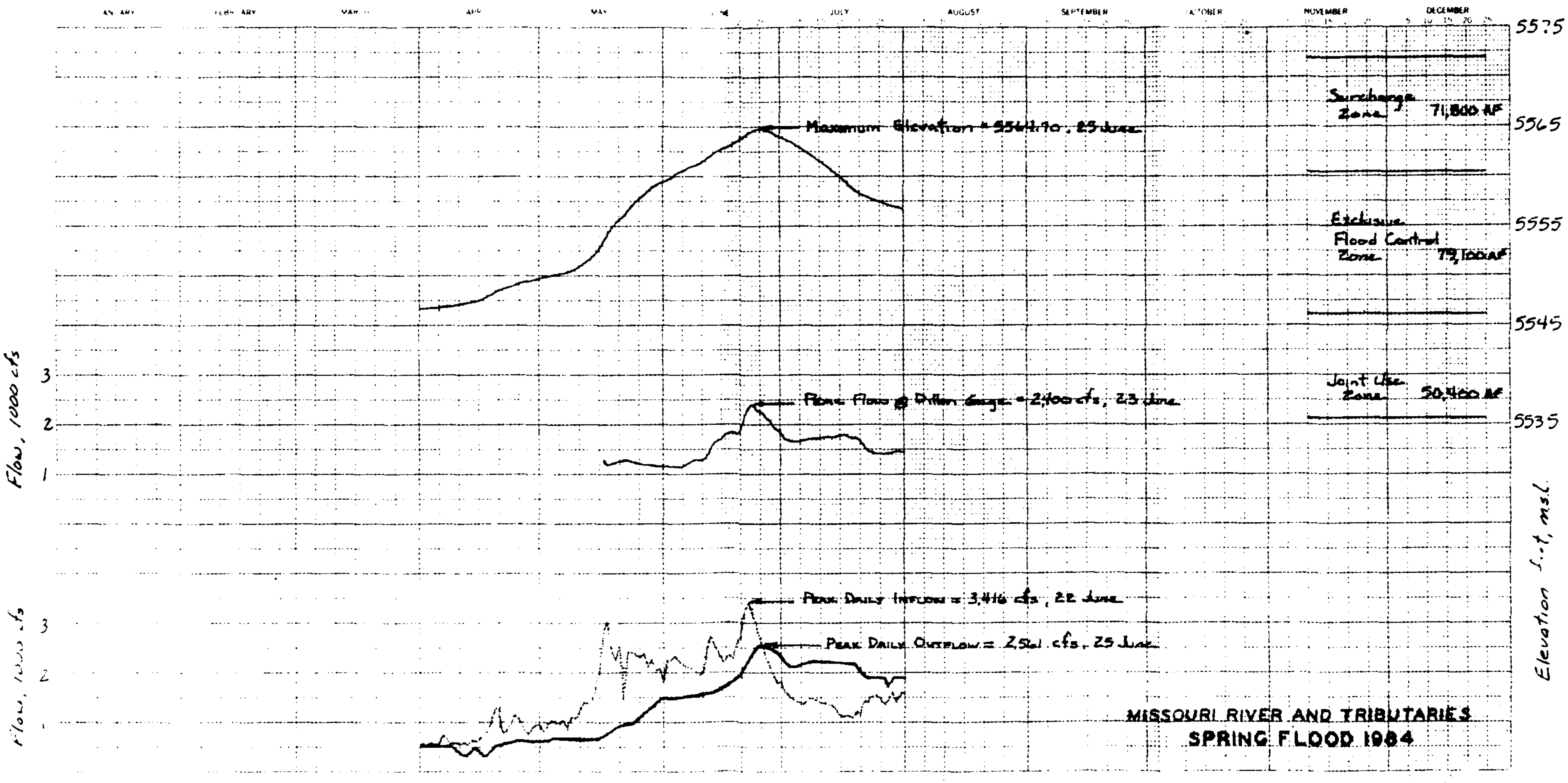
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

PLATE 2

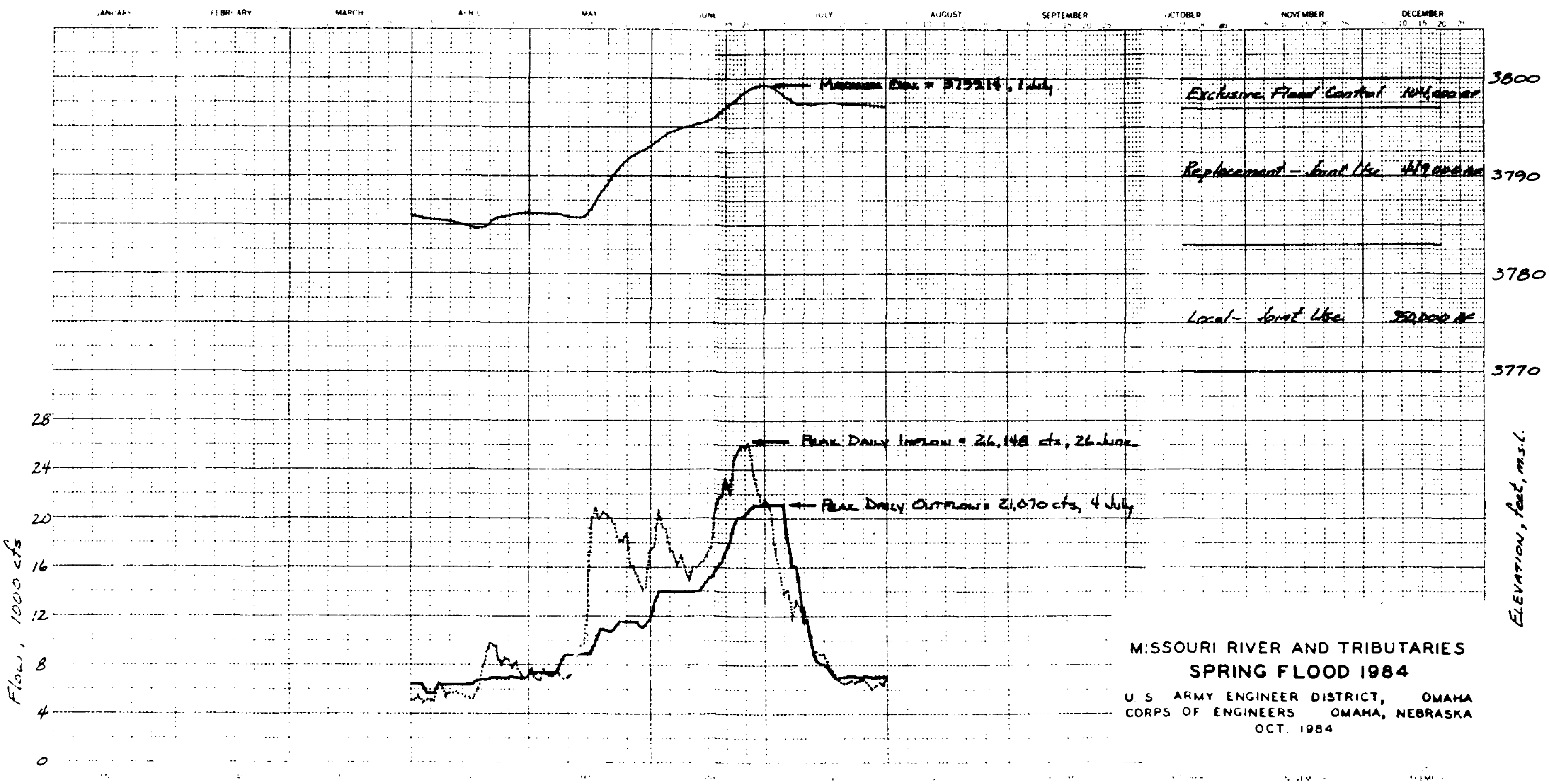


MISSOURI RIVER AND TRIBUTARIES
POST-FLOOD REPORT
SPRING FLOODS 1984
REPRESENTATIVE
MASS RAINFALL CURVES
MONTANA - JUNE 1984
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

PLATE 3



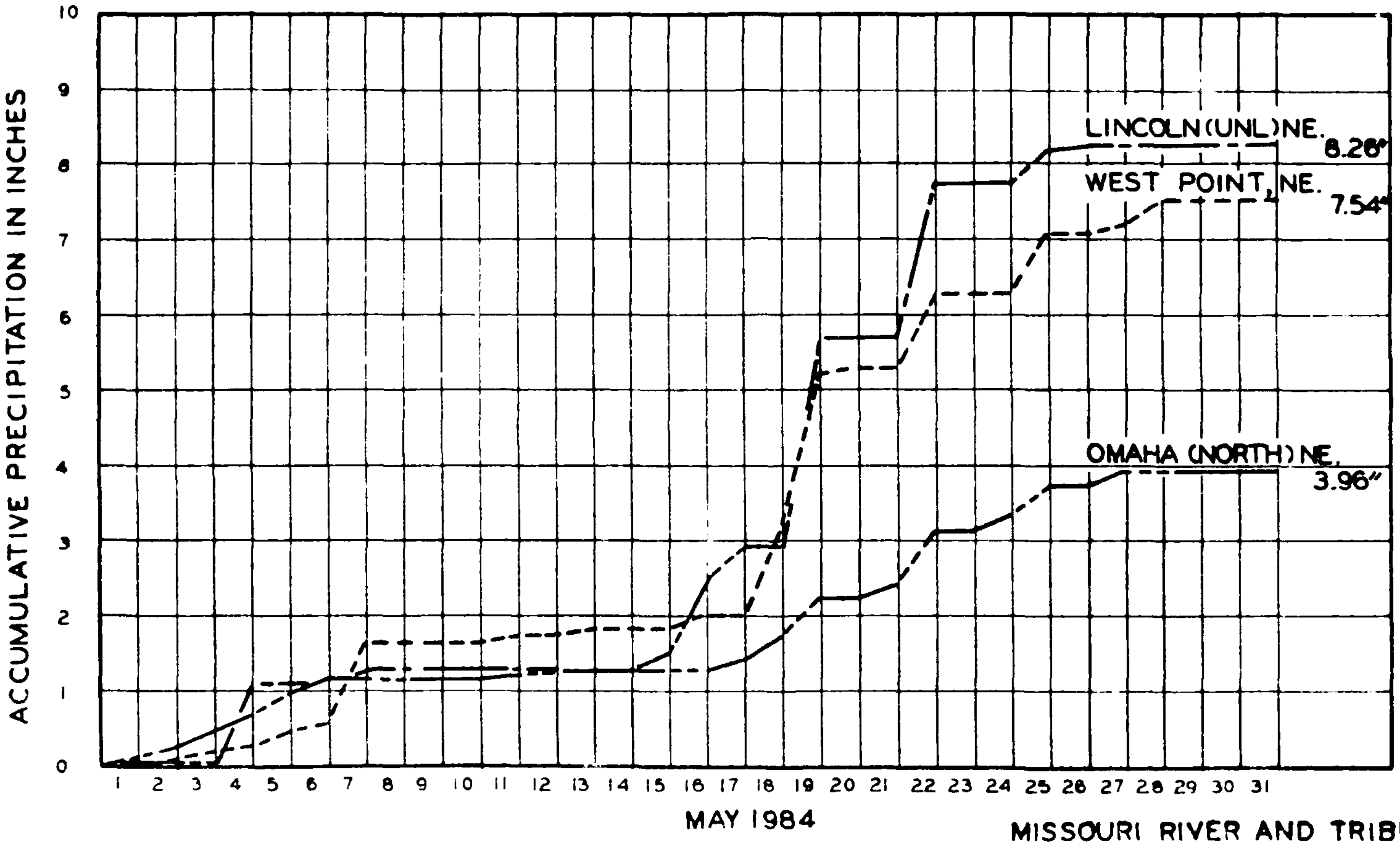
Clark Canyon



MISSOURI RIVER AND TRIBUTARIES
SPRING FLOOD 1984

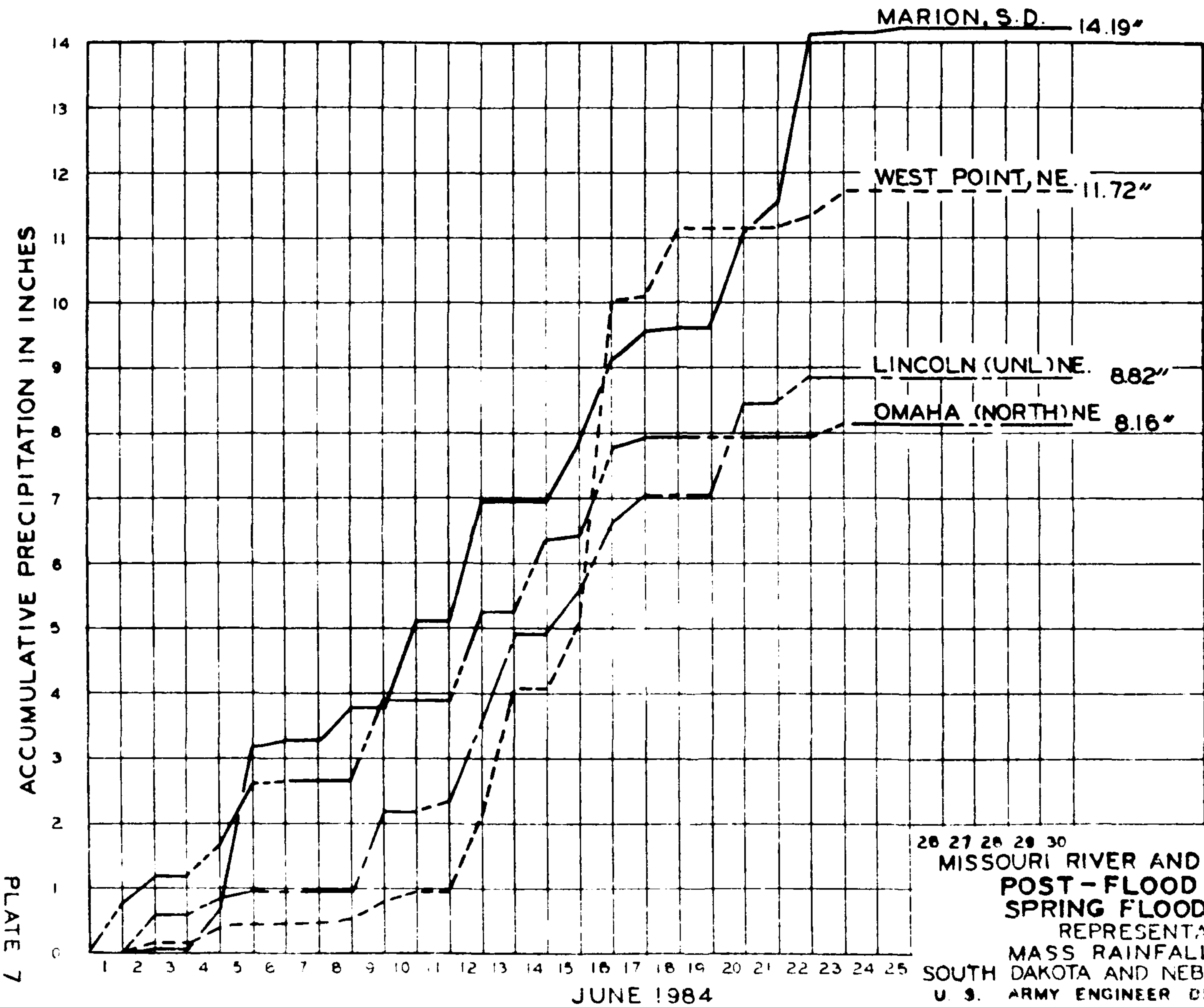
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

CANYON FERRY
1984



MISSOURI RIVER AND TRIBUTARIES
POST-FLOOD REPORT
SPRING FLOODS 1984
REPRESENTATIVE
MASS RAINFALL CURVES
NEBRASKA - MAY 1984
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

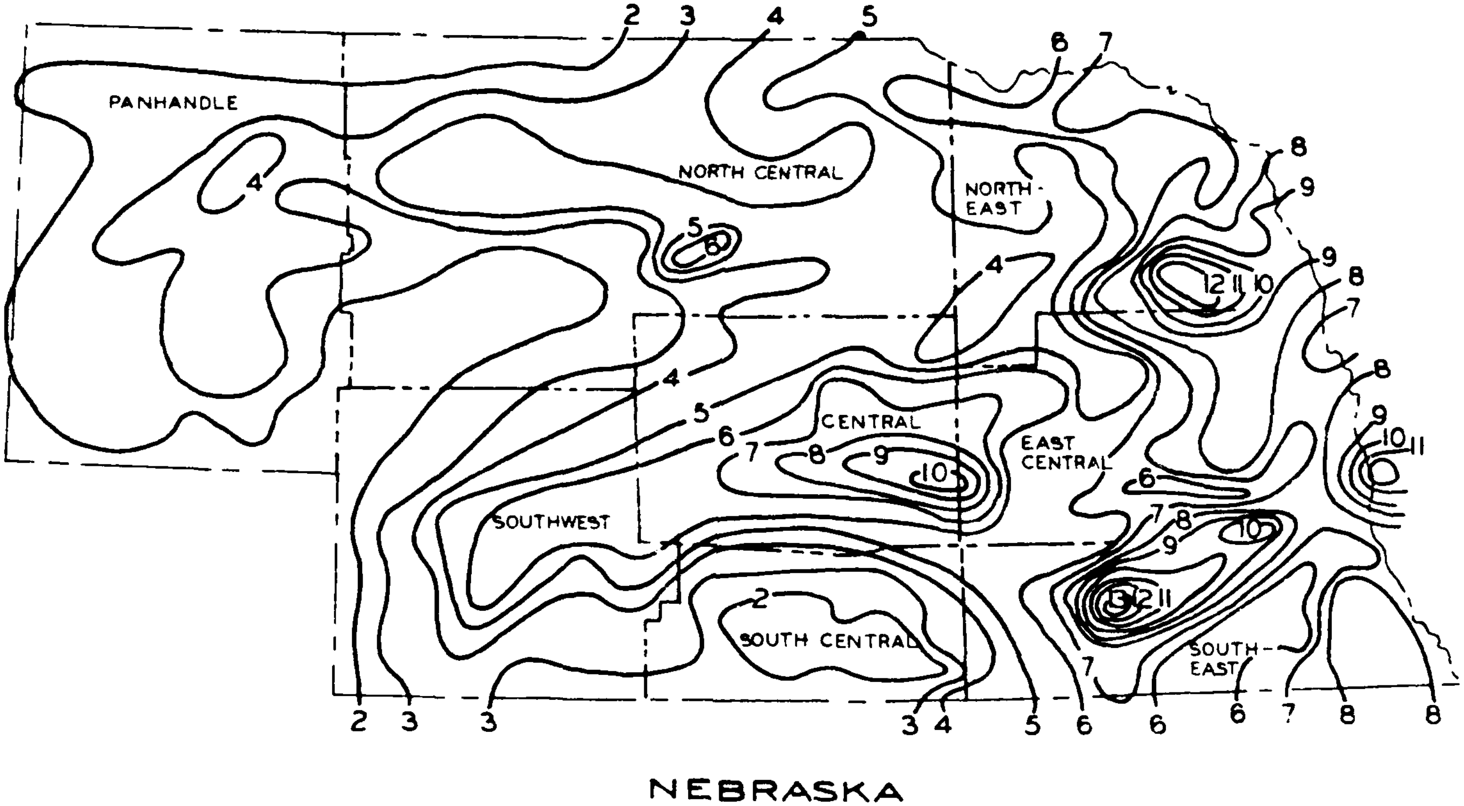
PLATE 8



MISSOURI RIVER AND TRIBUTARIES
POST-FLOOD REPORT
SPRING FLOODS 1984
REPRESENTATIVE
MASS RAINFALL CURVES
SOUTH DAKOTA AND NEBRASKA - JUNE 1984

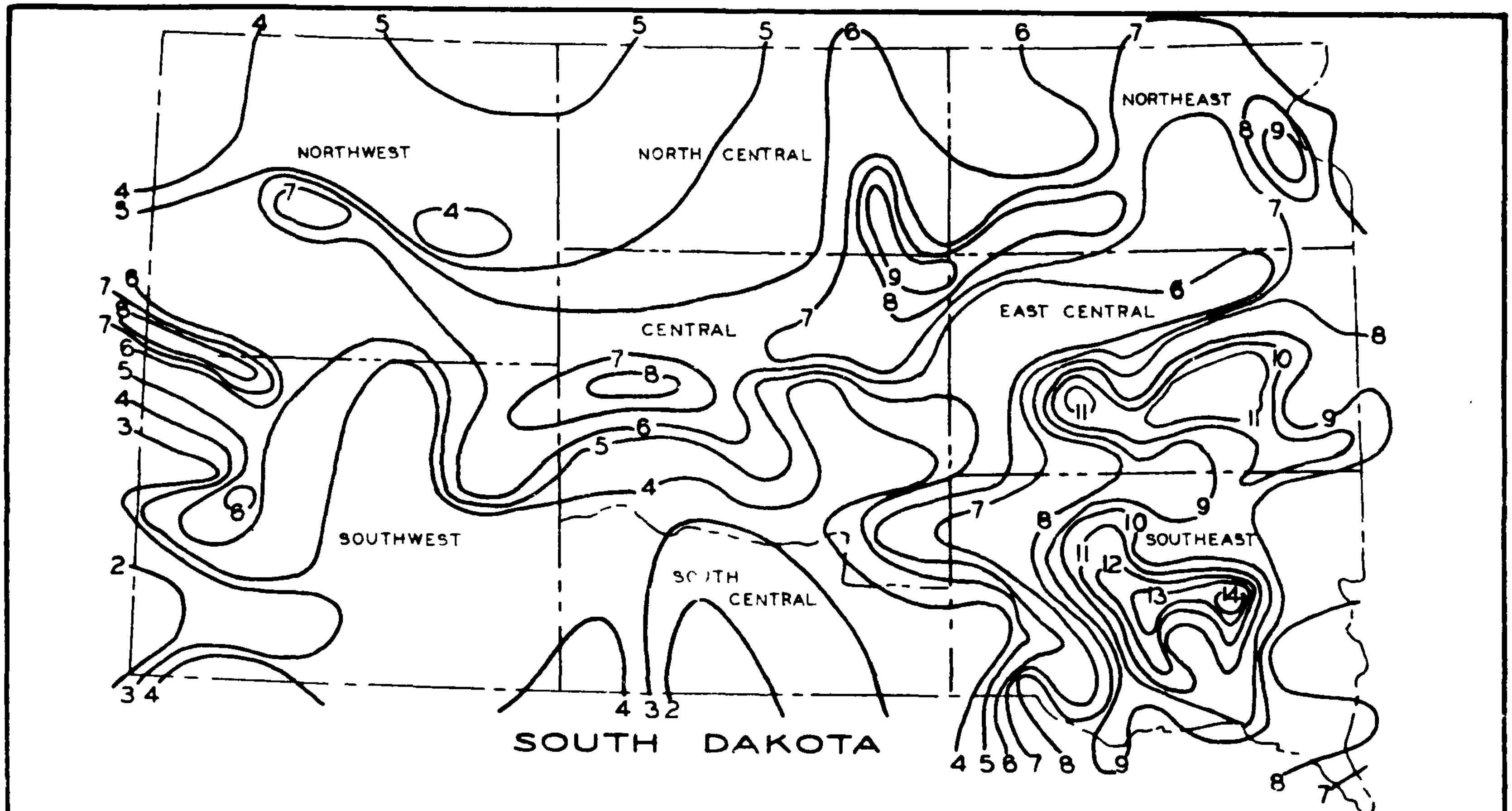
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

PLATE 7



MISSOURI RIVER AND TRIBUTARIES
POST-FLOOD REPORT
SPRING FLOODS 1984
TOTAL PRECIPITATION - INCHES
NEBRASKA - JUNE 1984
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

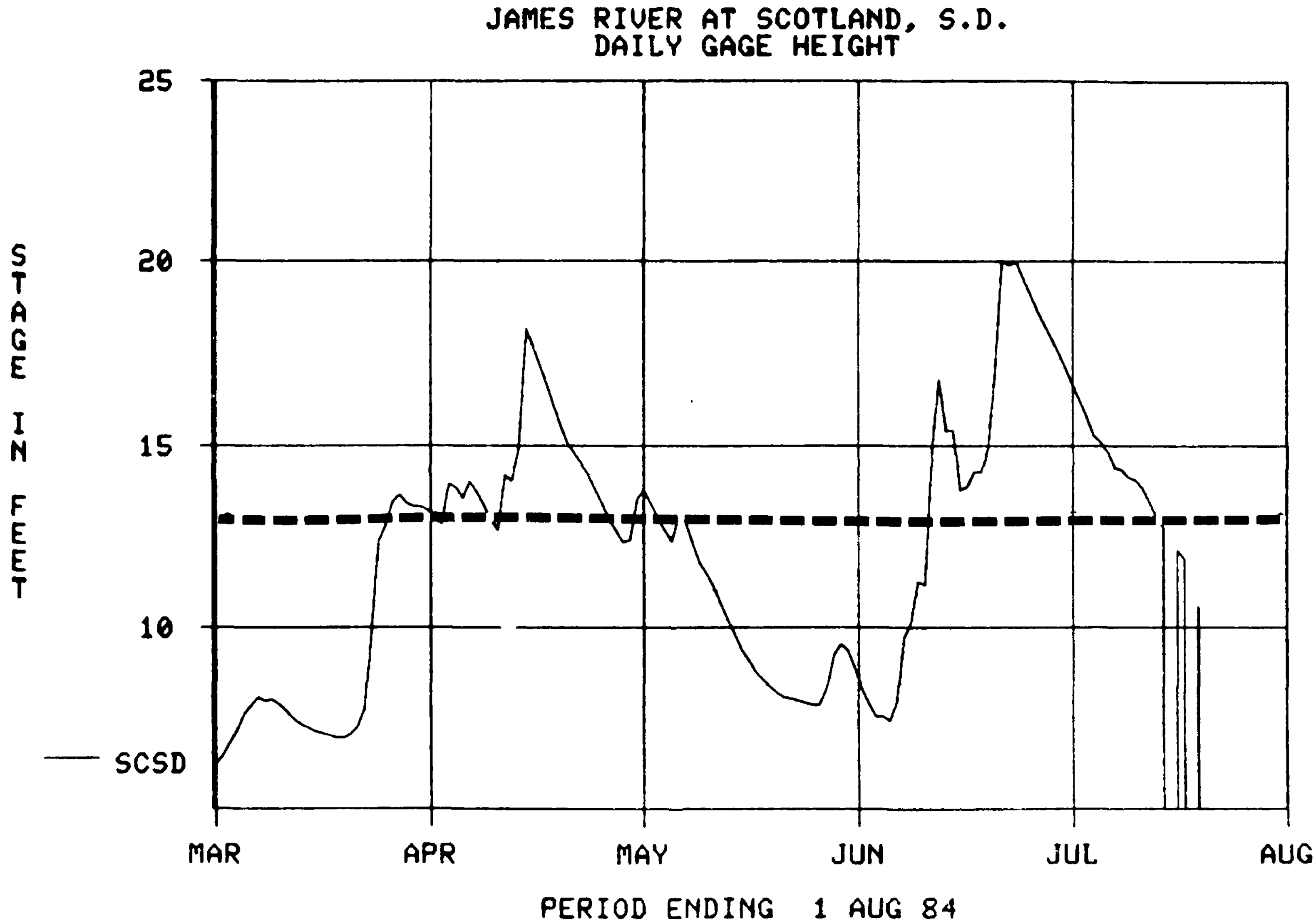
PLATE 8



MISSOURI RIVER AND TRIBUTARIES
POST-FLOOD REPORT
SPRING FLOODS 1984
TOTAL PRECIPITATION - INCHES
SOUTH DAKOTA - JUNE 1984

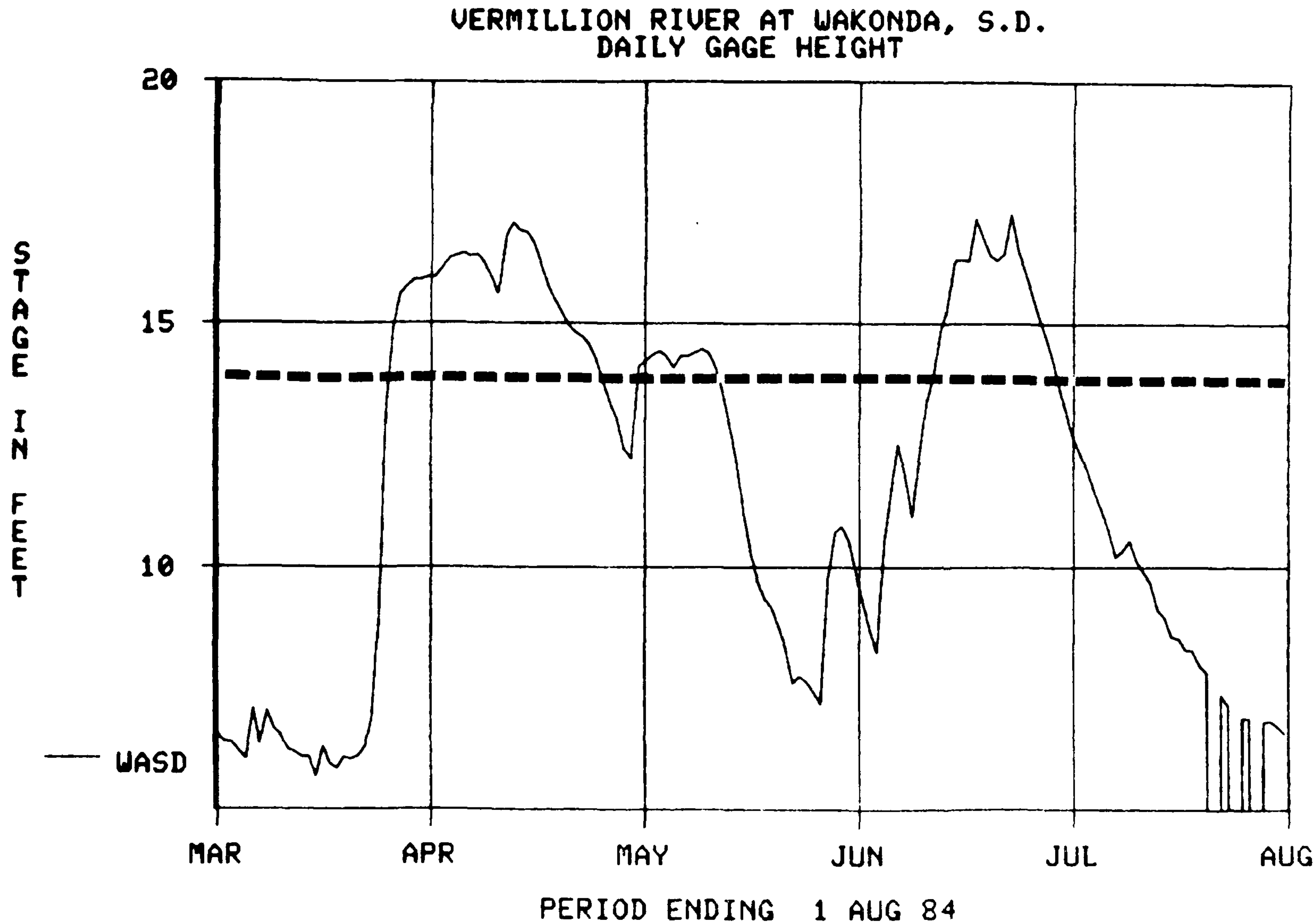
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

PLATE 9



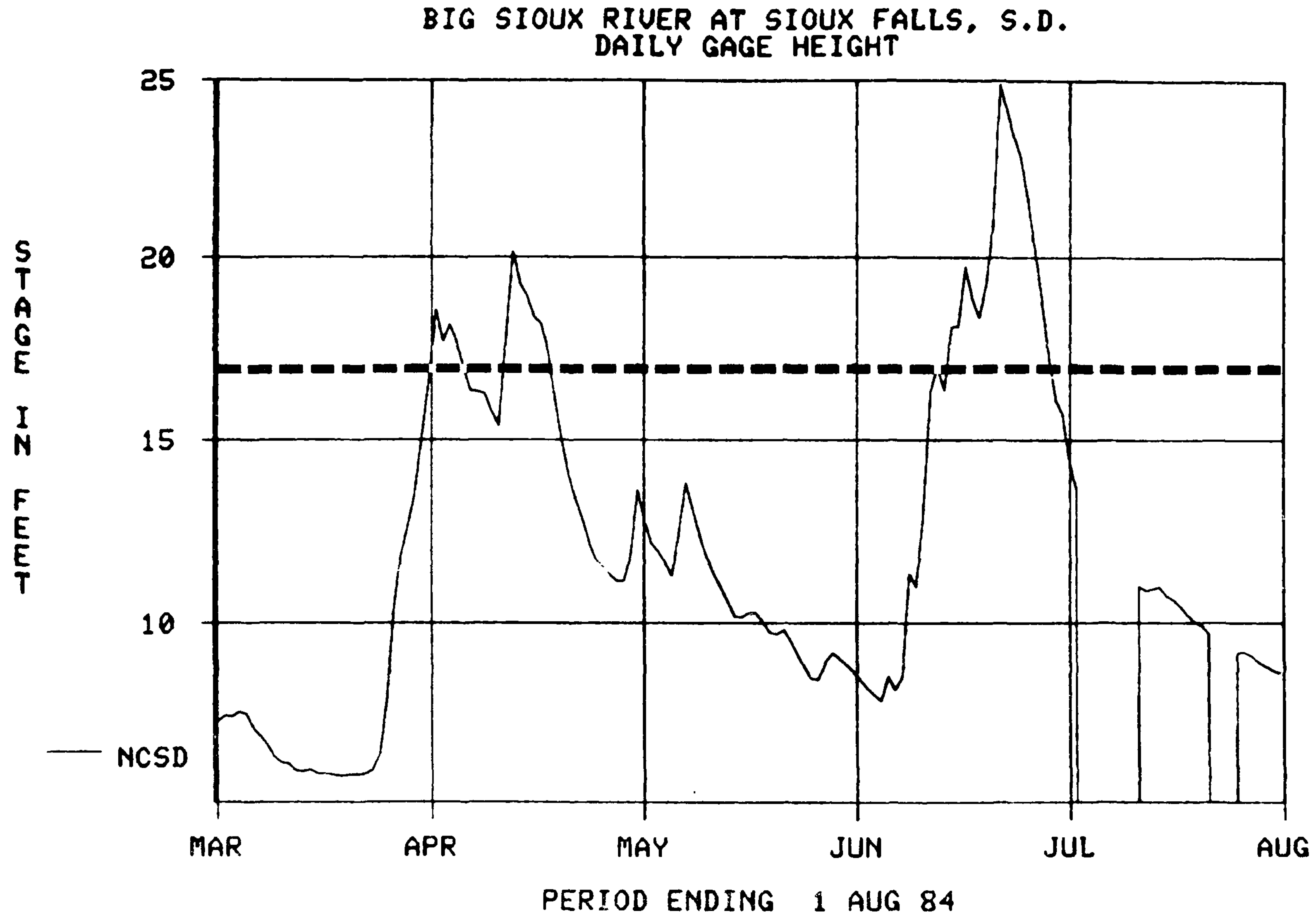
FLOOD STAGE = 13 ft. M.S.L.

PLATE



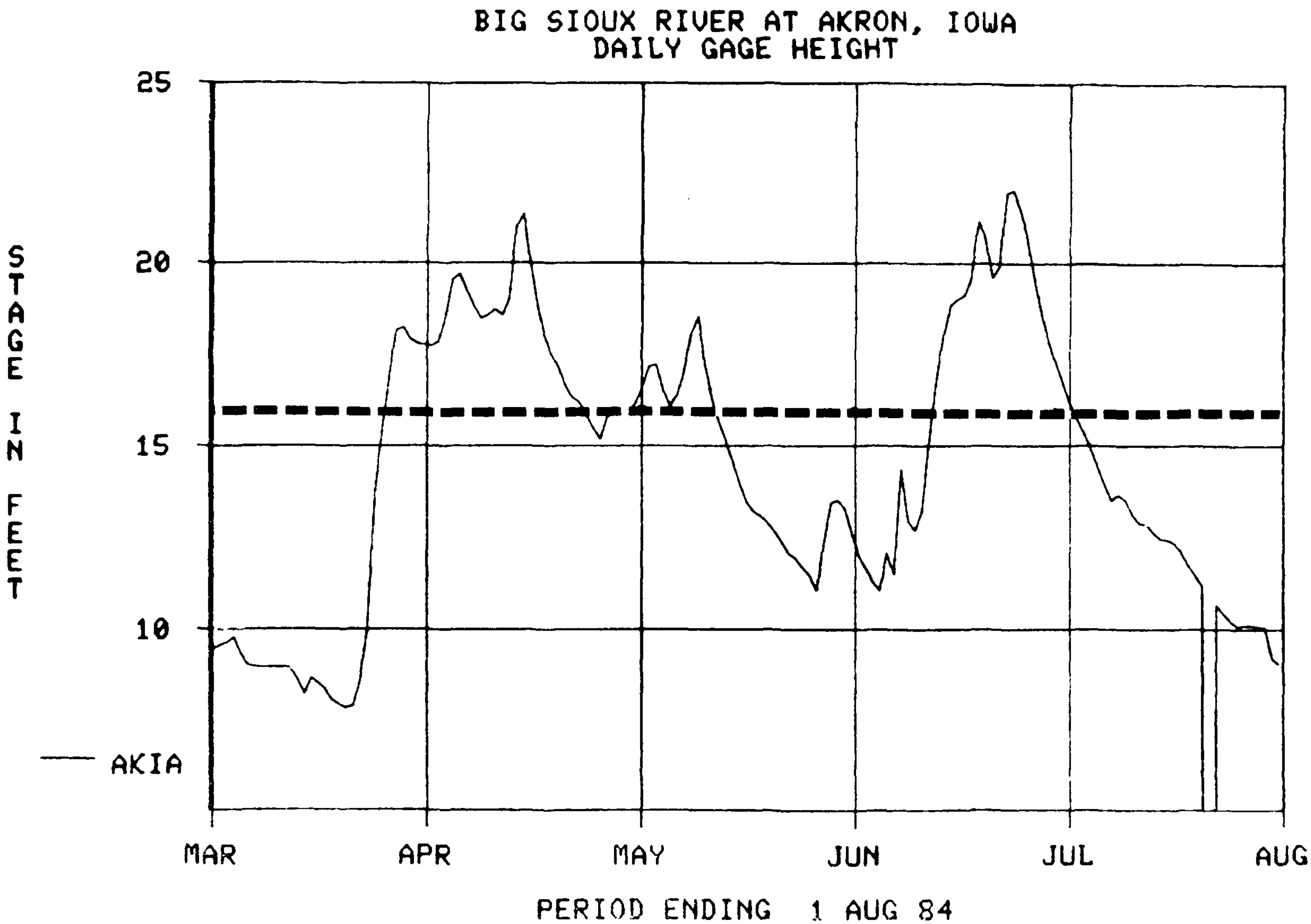
FLOOD STAGE = 14 ft. M.S.L.

PLATE



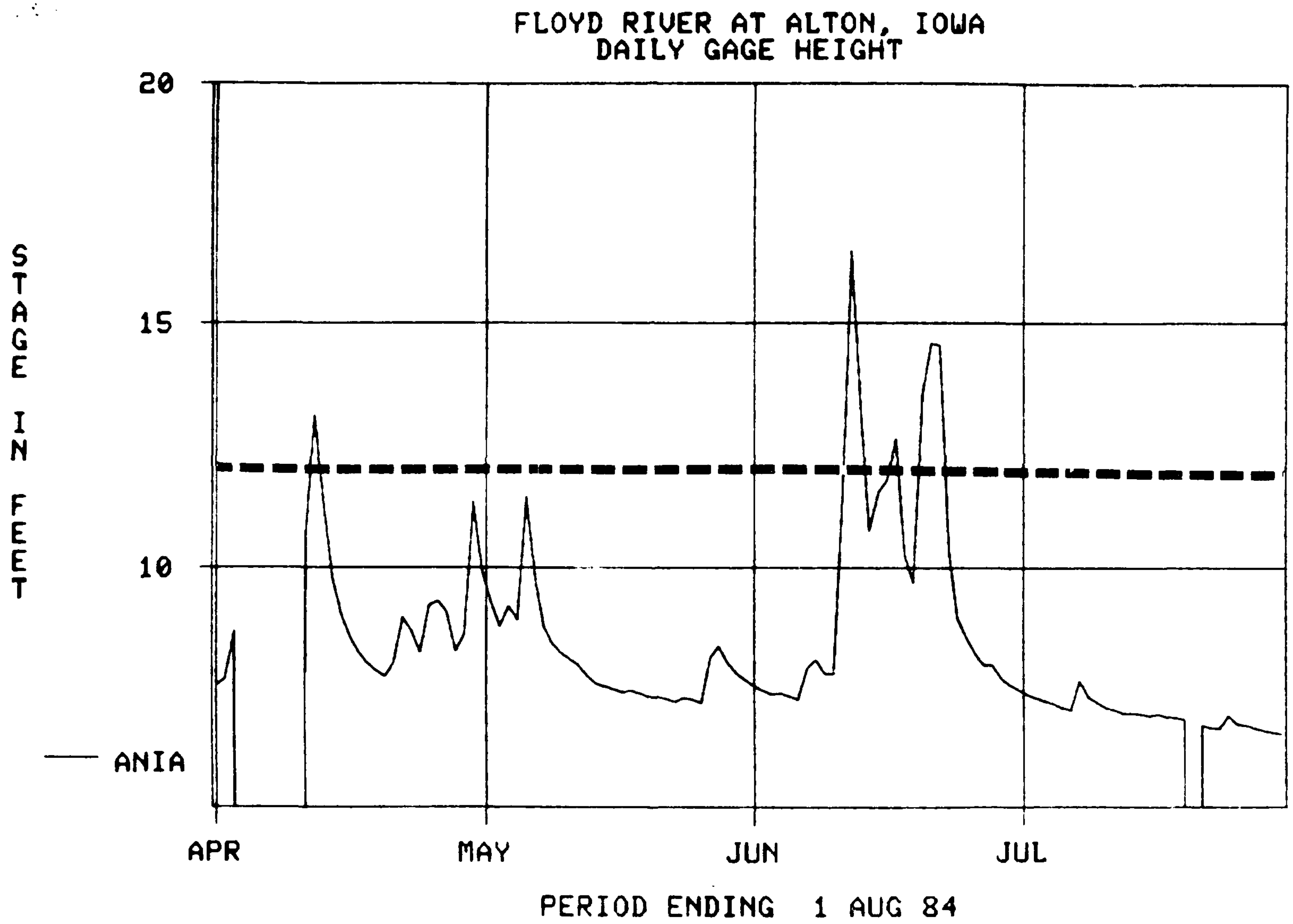
FLOOD STAGE = 16 ft. M.S.L.

PLATE



BIG SIOUX RIVER AT AKRON, IOWA
DAILY GAGE HEIGHT
STAGE IN FEET
25
20
15
10
AKIA
MAR
APR
MAY
JUN
JUL
AUG
PERIOD ENDING 1 AUG 84

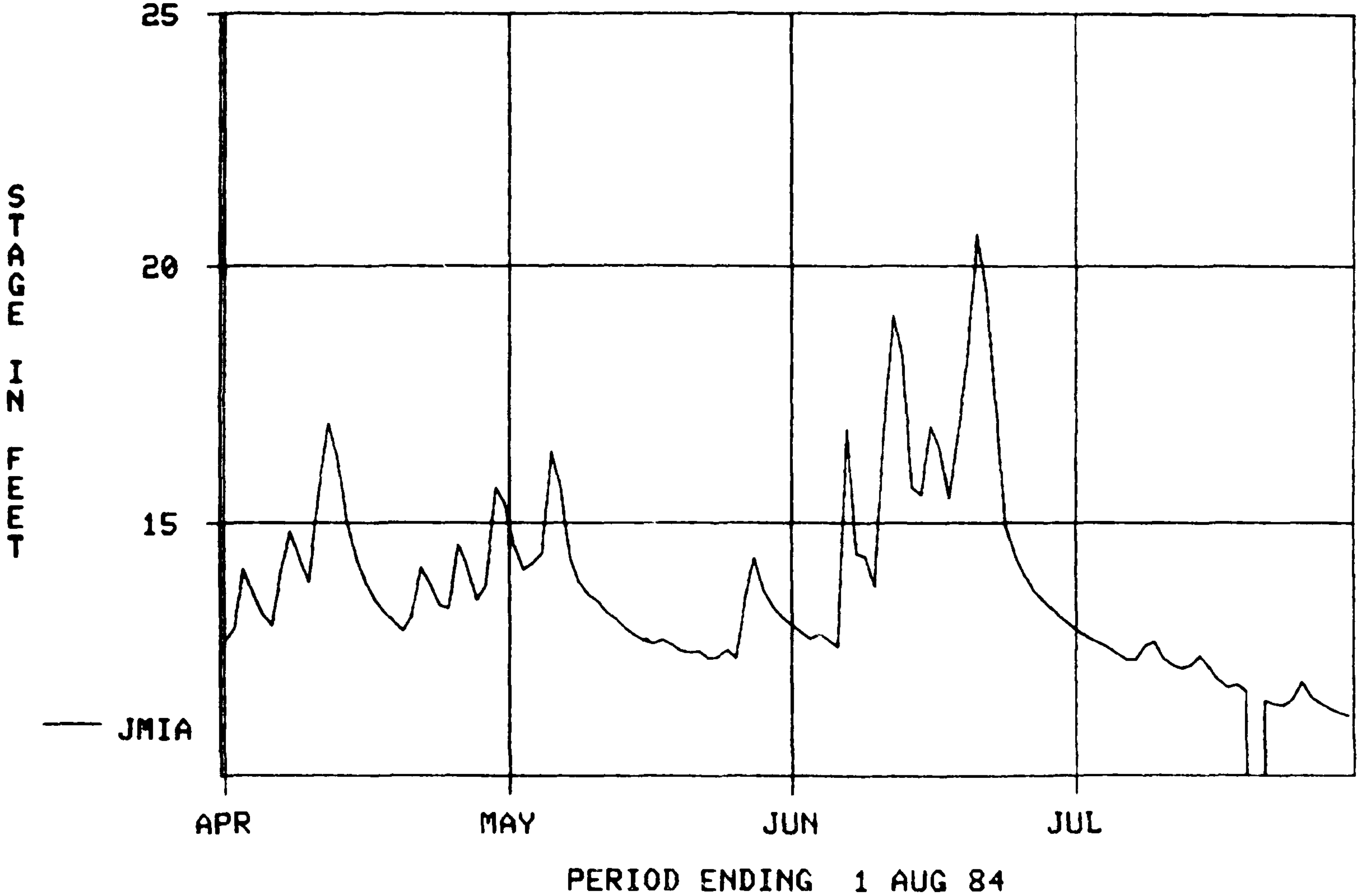
PLATE



FLOOD STAGE = 12 ft. M.S.L.

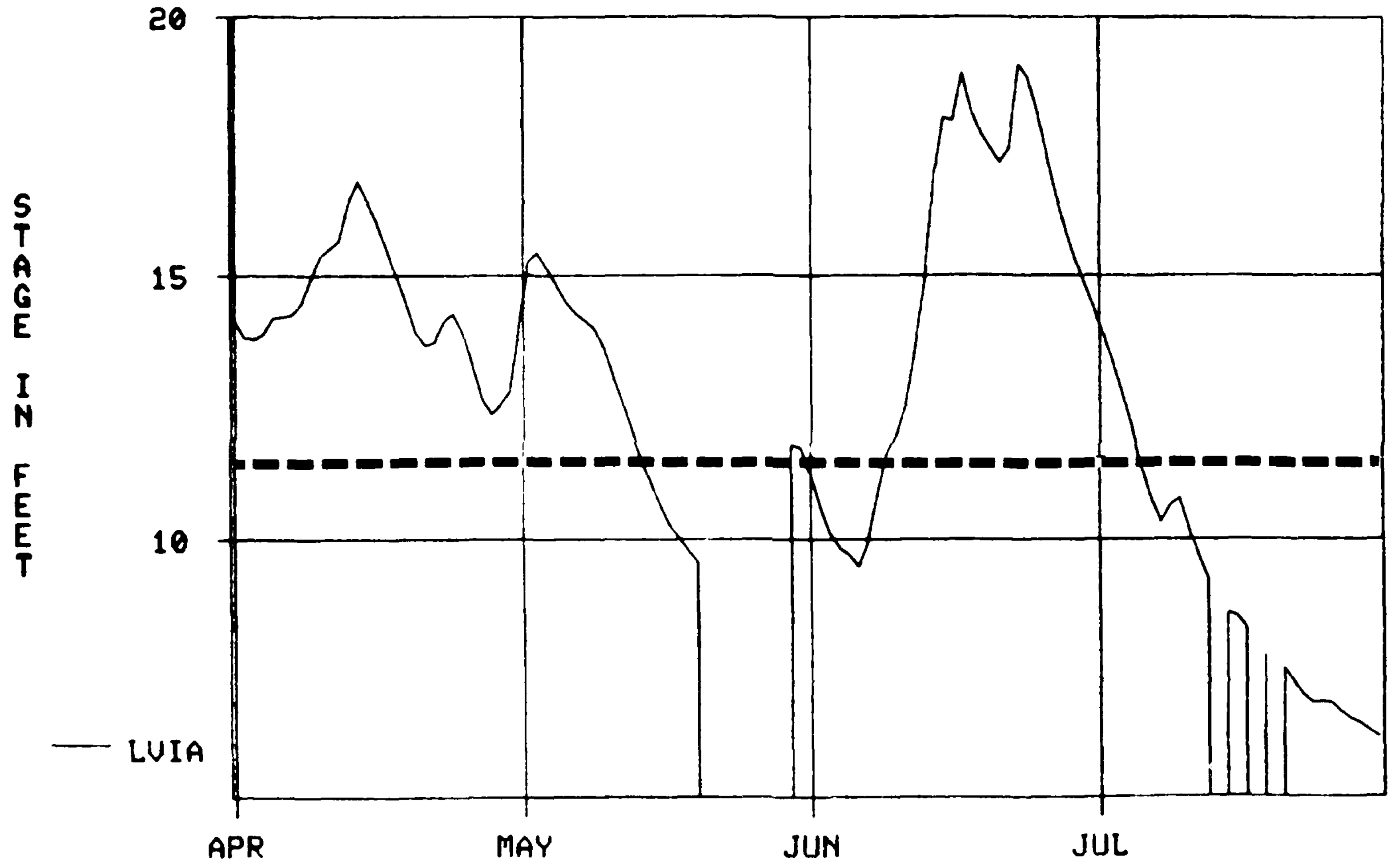
PLATE

FLOYD RIVER AT JAMES, IOWA
DAILY GAGE HEIGHT



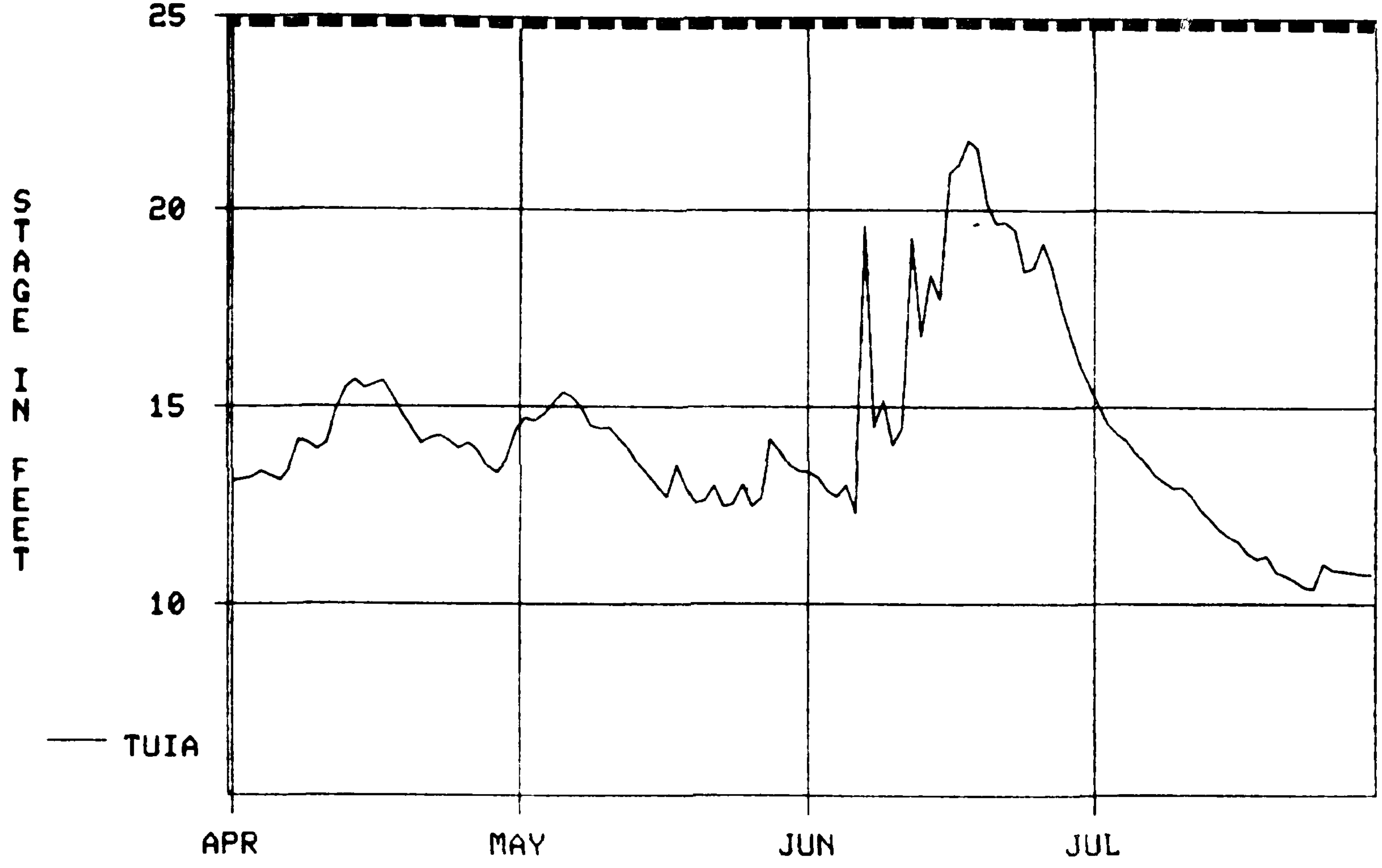
FLOOD STAGE = 26 ft. M.S.L.

LITTLE SIOUX RIVER AT LINN GROVE, IOWA
DAILY GAGE HEIGHT



FLOOD STAGE = 1_ ft. M.S.L.

LITTLE SIOUX RIVER AT TURIN, IOWA
DAILY GAGE HEIGHT

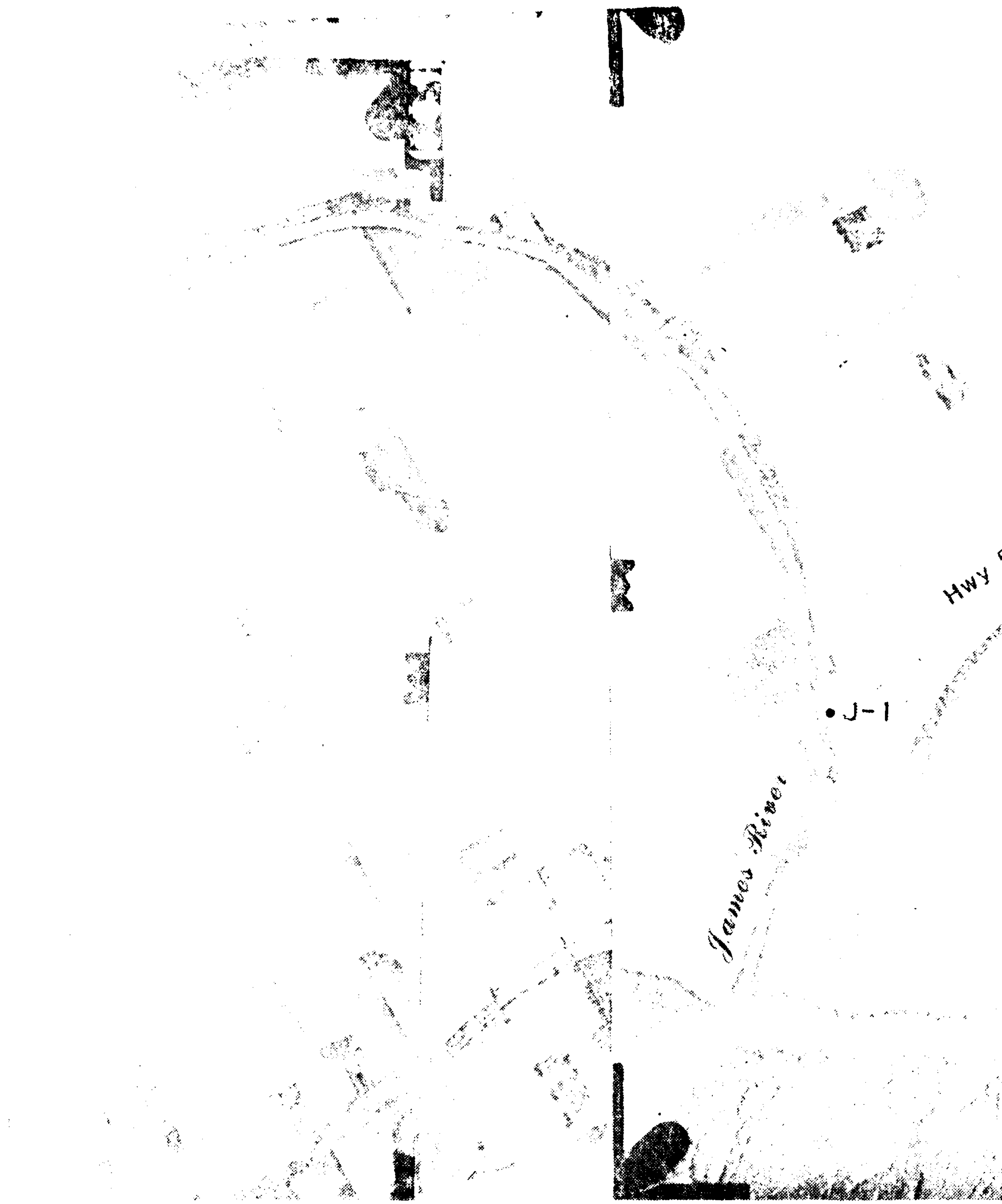


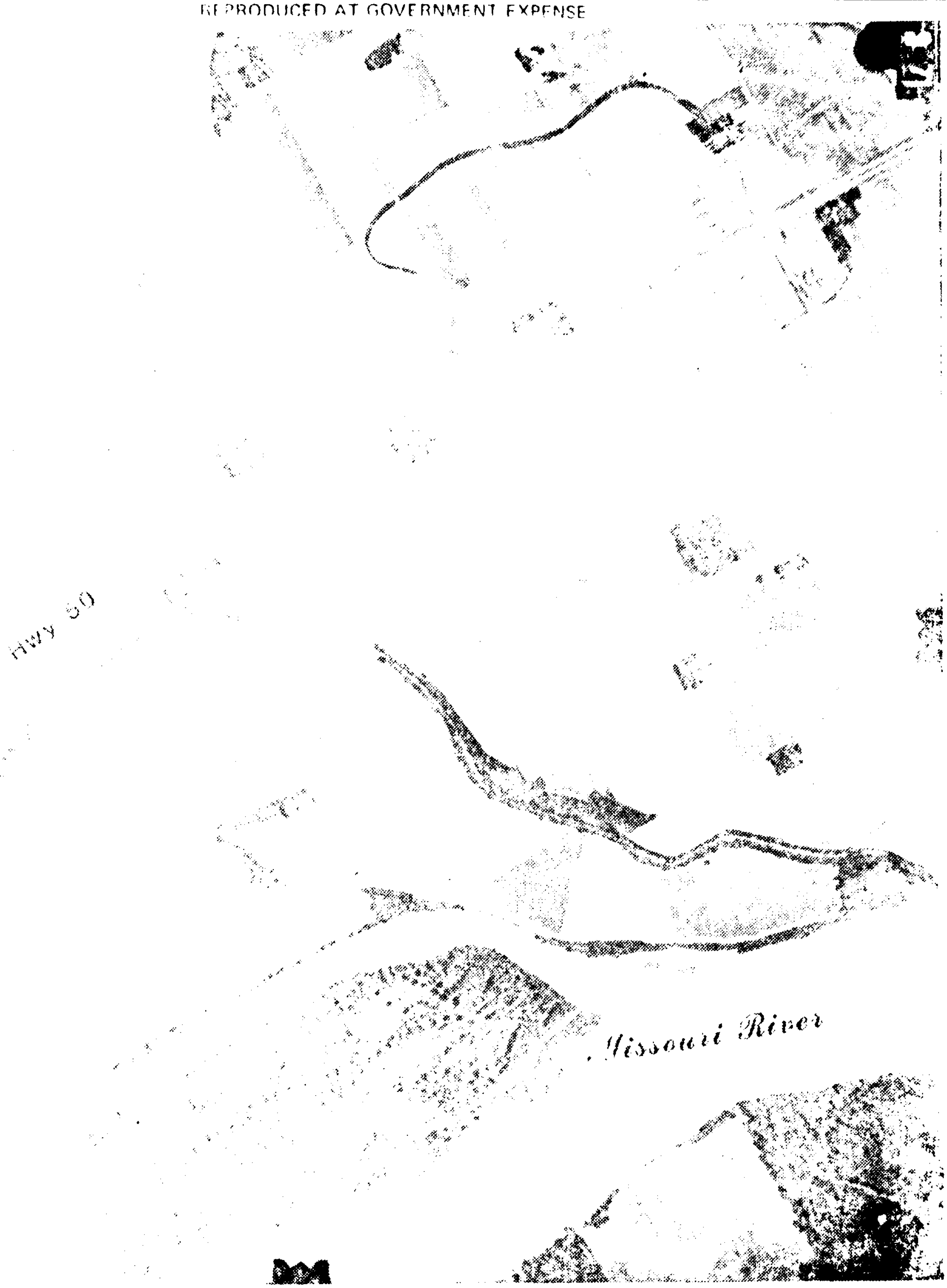
PERIOD ENDING 1 AUG 84

FLOOD STAGE = 25 ft. M.S.L.

PLATE 17


J-3
J-2
YANKTON


Hwy 5
J-1
James River



MISSOURI RIVER AND TRIBUTARIE

SPRING FLOOD 1984

U S ARMY ENGINEER DISTRICT, OMA
CORPS OF ENGINEERS OMAHA, NEBRA
OCT. 1984

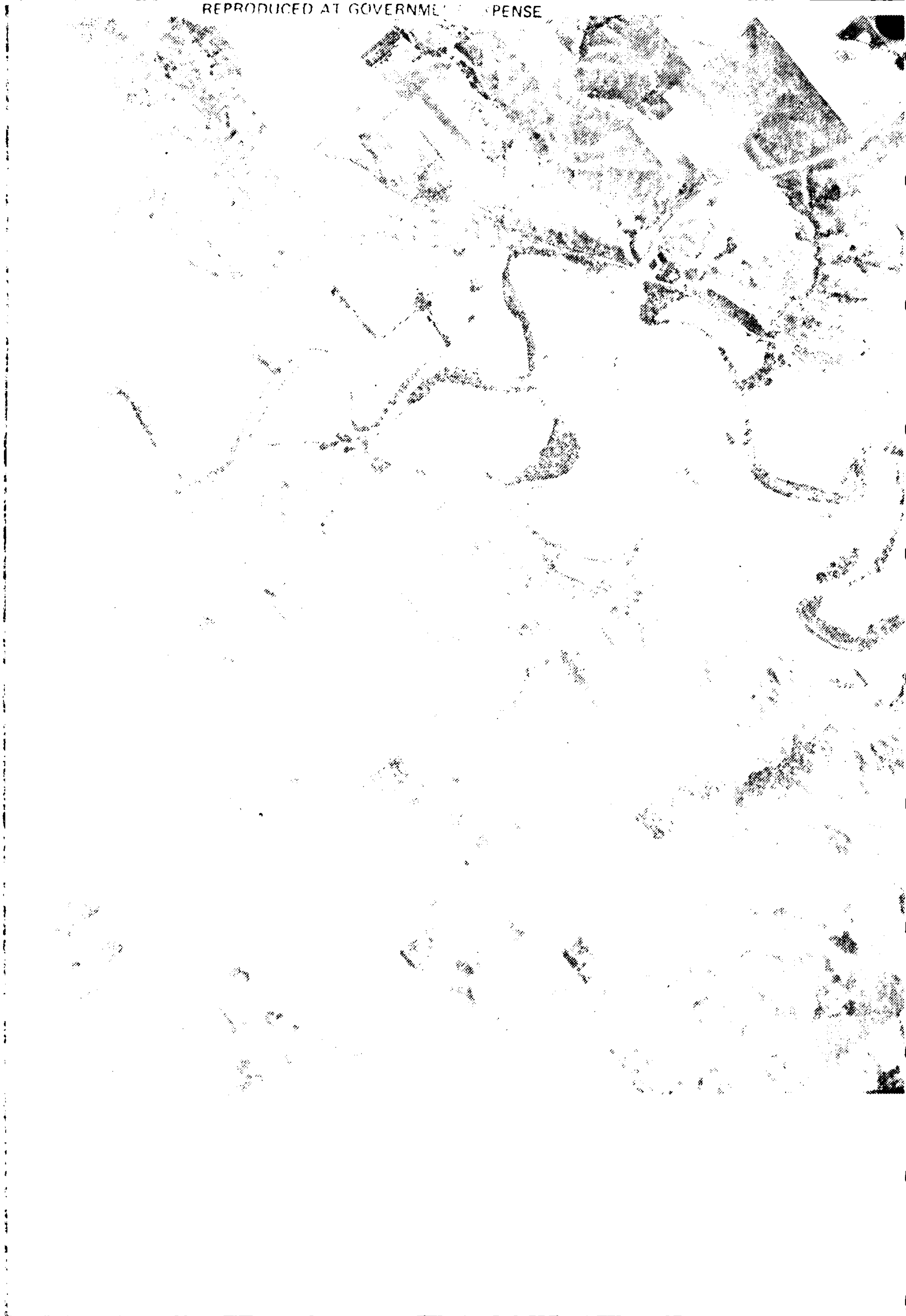
PLATE

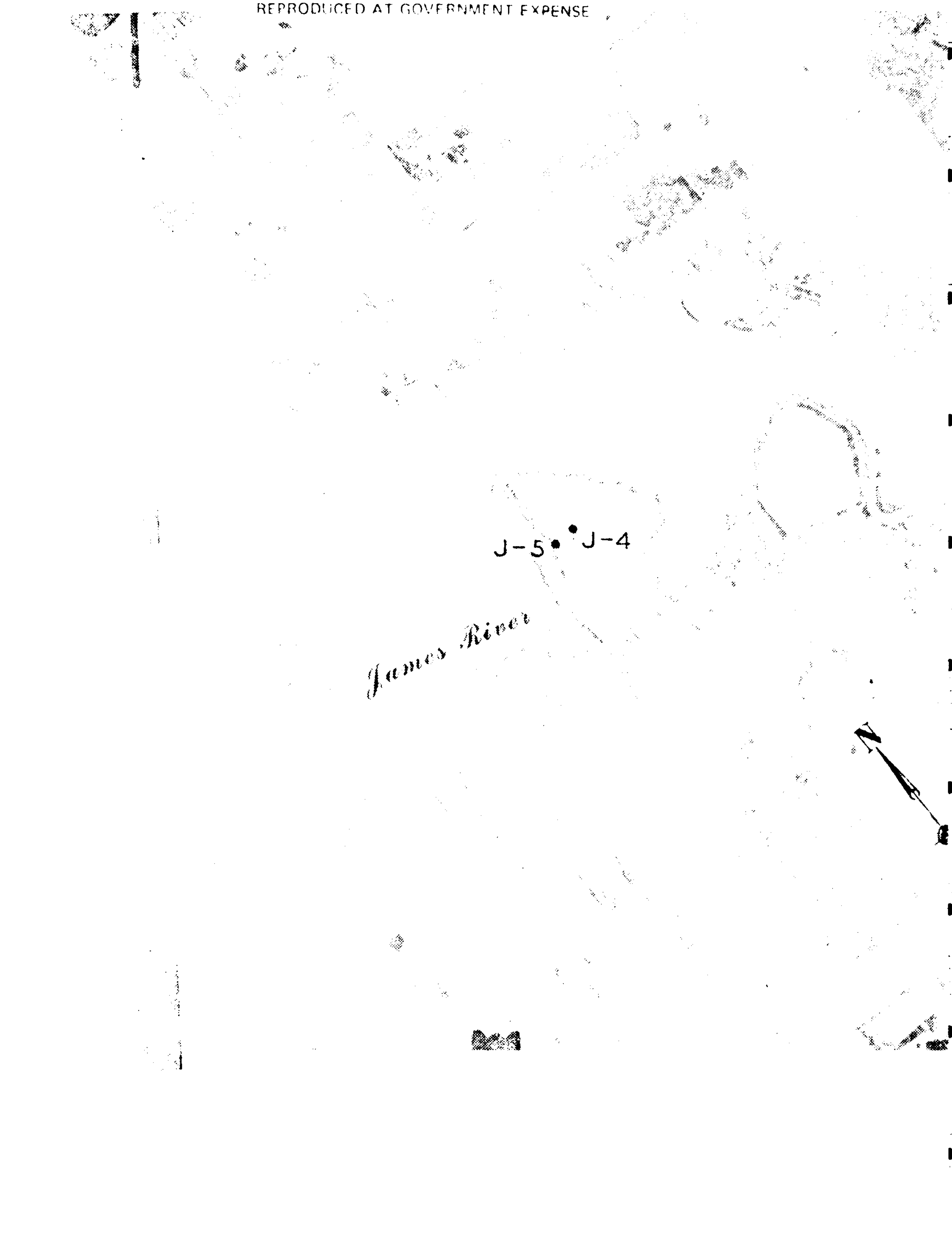

James River

MISSION HILL

MISSOURI RIVER AND TRIBUTARIES
SPRING FLOOD 1984
U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT 1984

PLATE



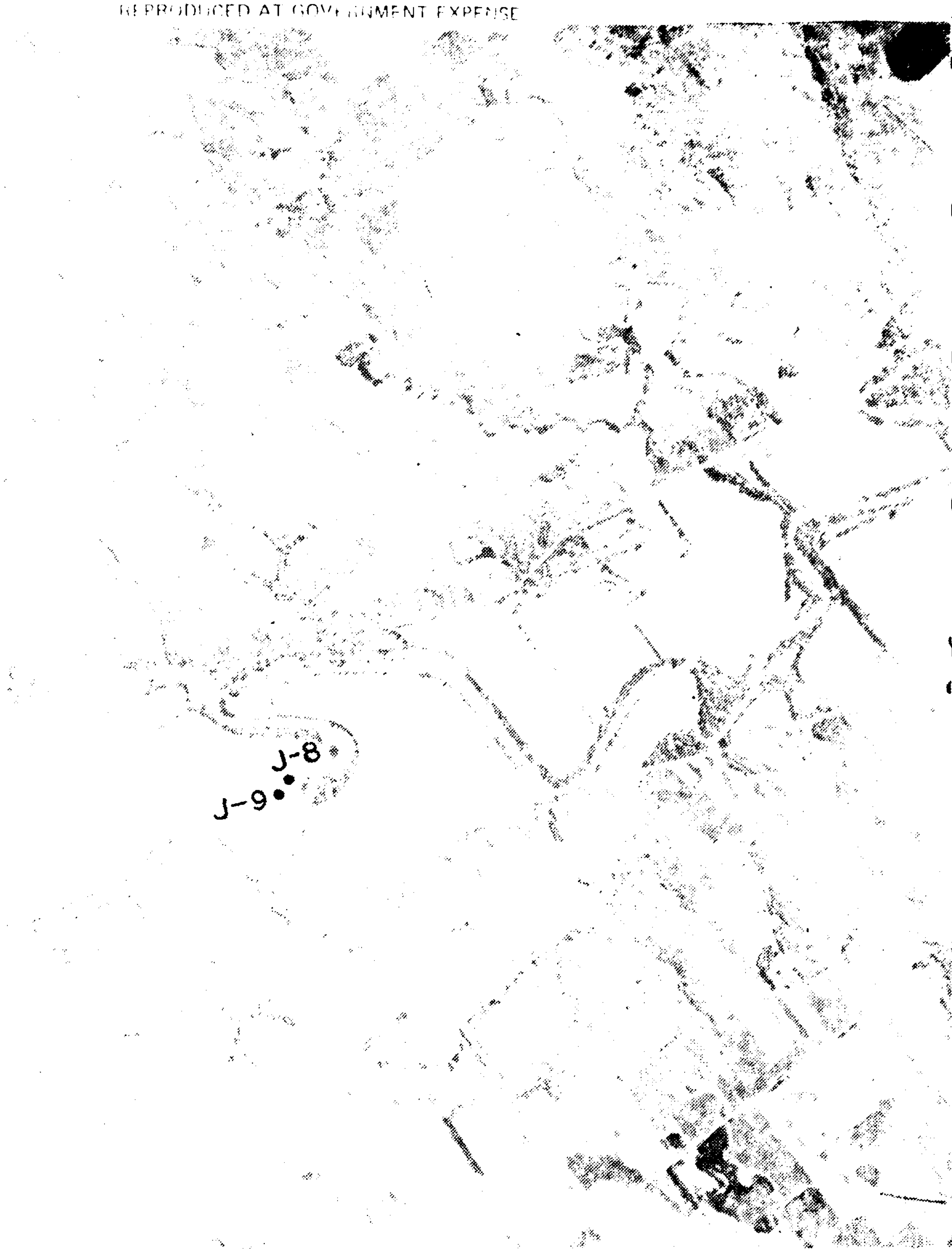

J-5
J-4
James River
N

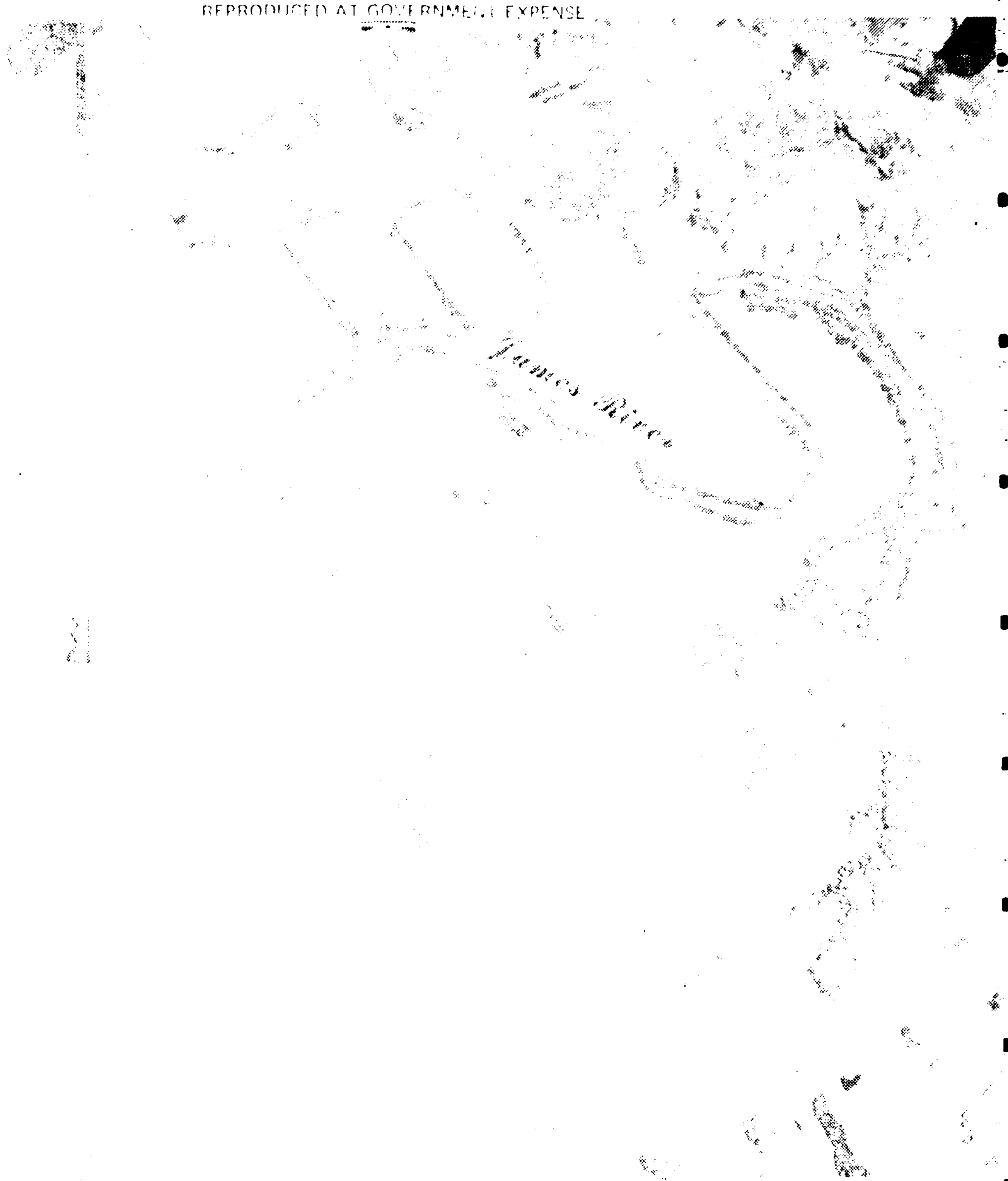
MISSOURI RIVER AND TRIBUTARIES

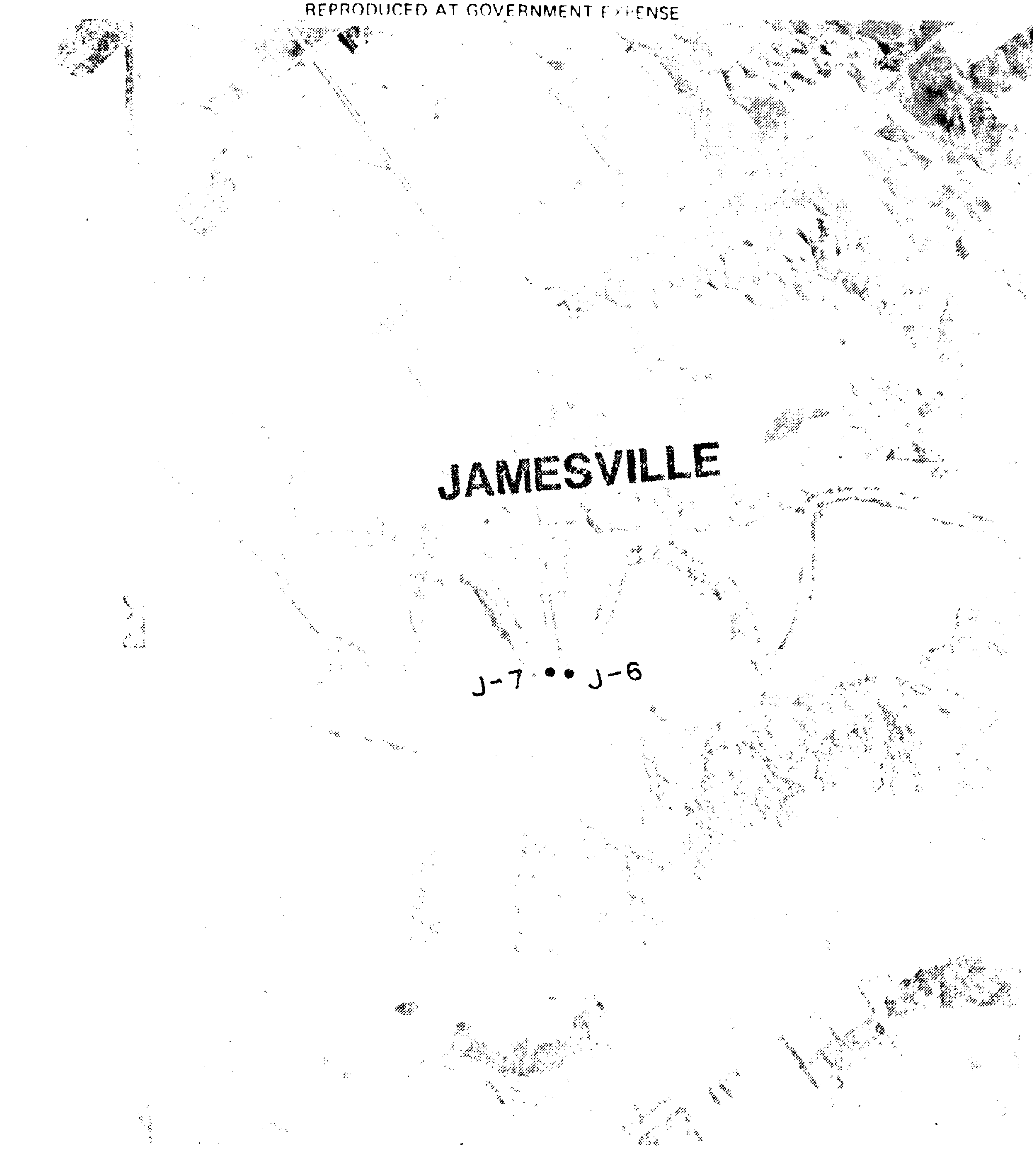
SPRING FLOOD 1984

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

PLATE 20


J-8
J-9


James River

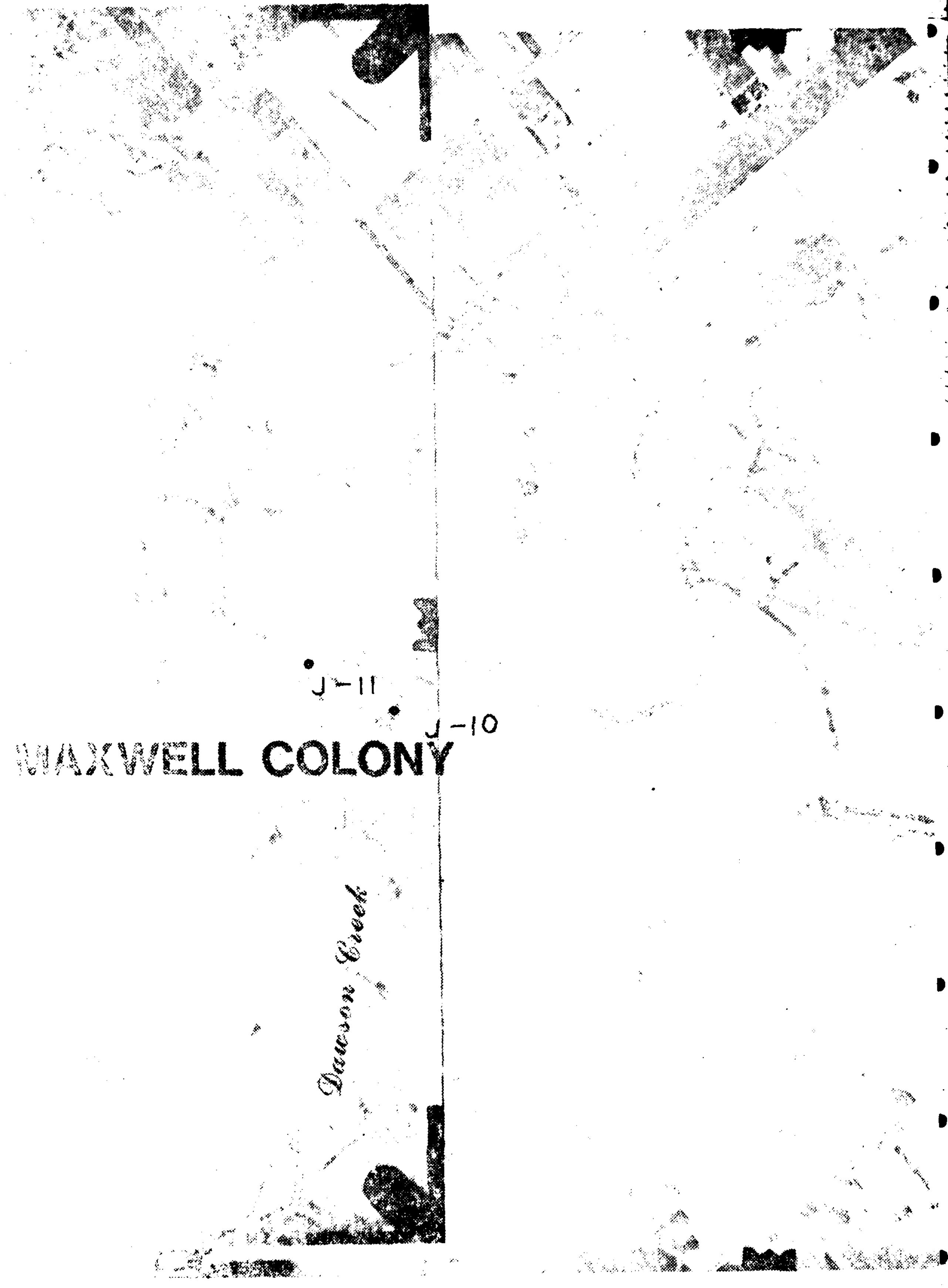


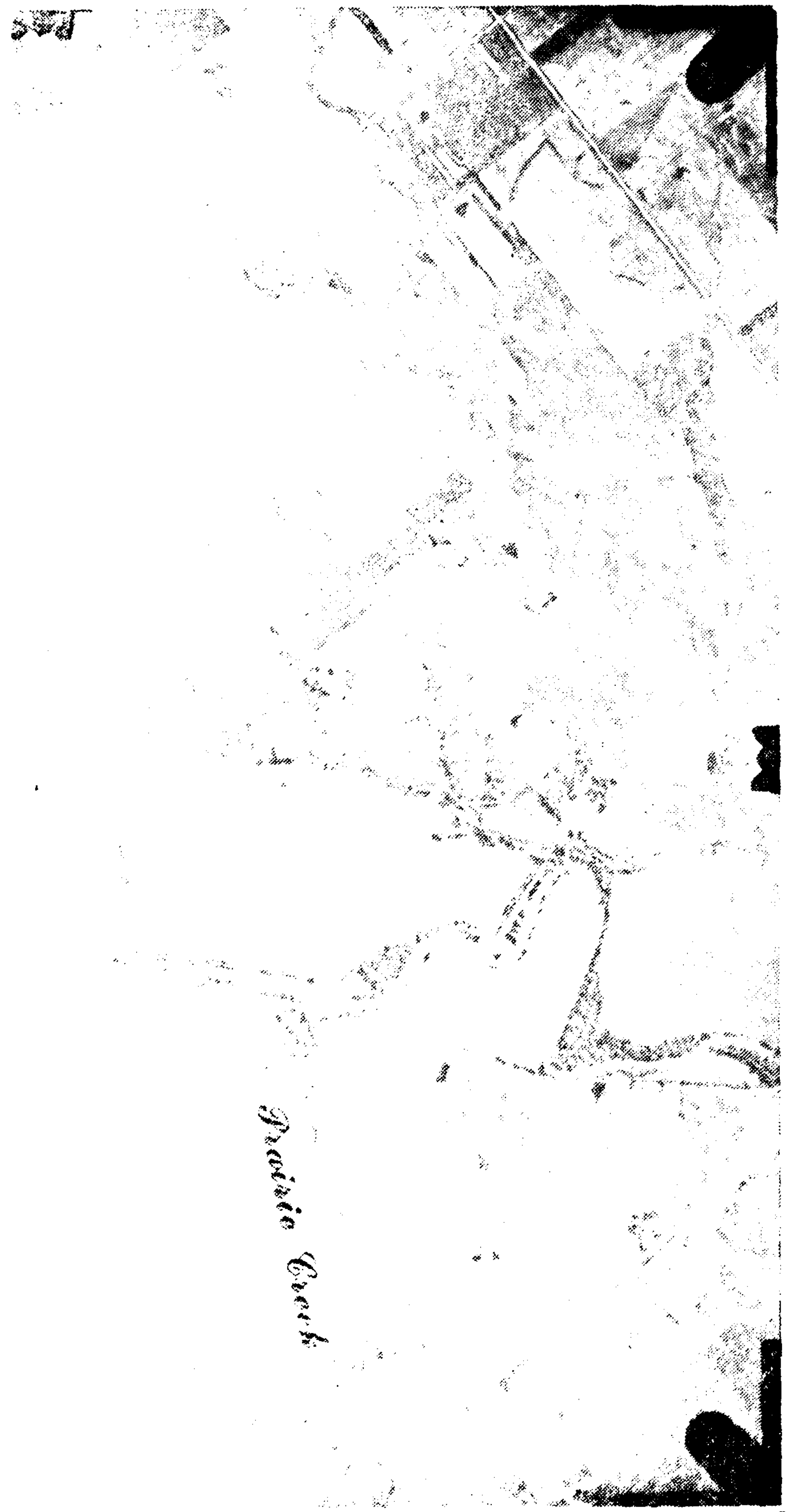
MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

PLATE 21


J-11
J-10
MAXWELL COLONY
Dawson Creek

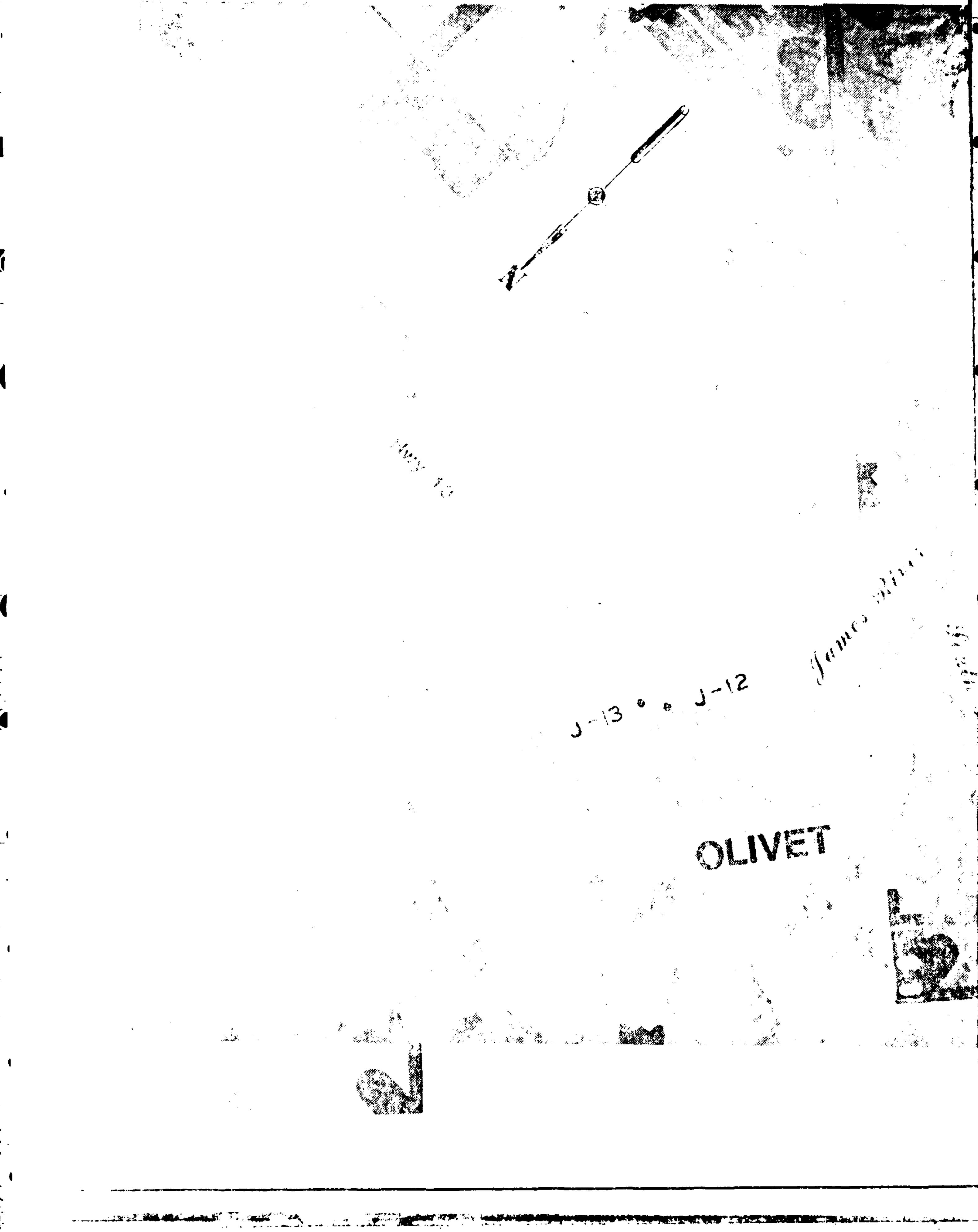


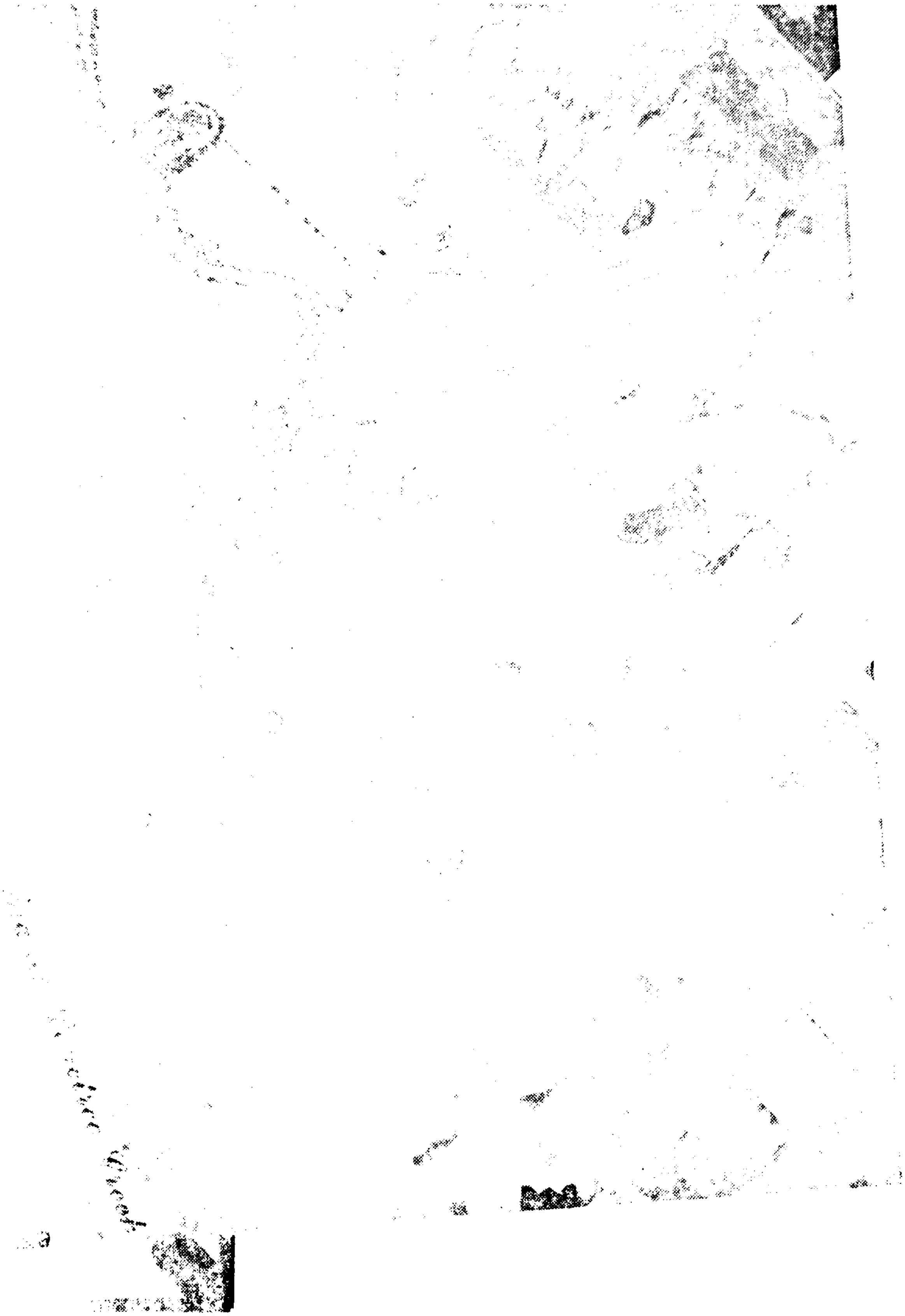
MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

PLATE 22

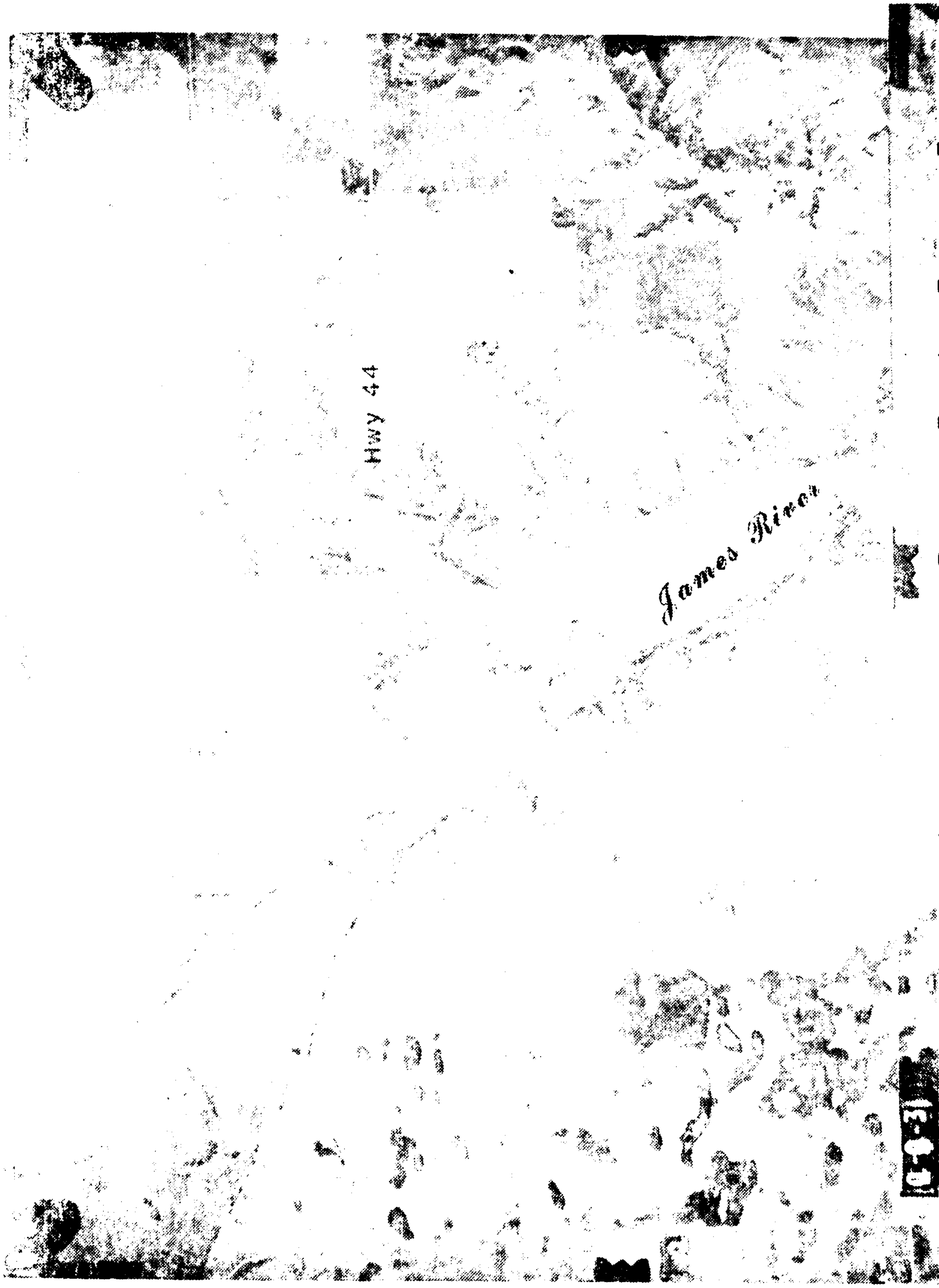

J-13
J-12
OLIVET

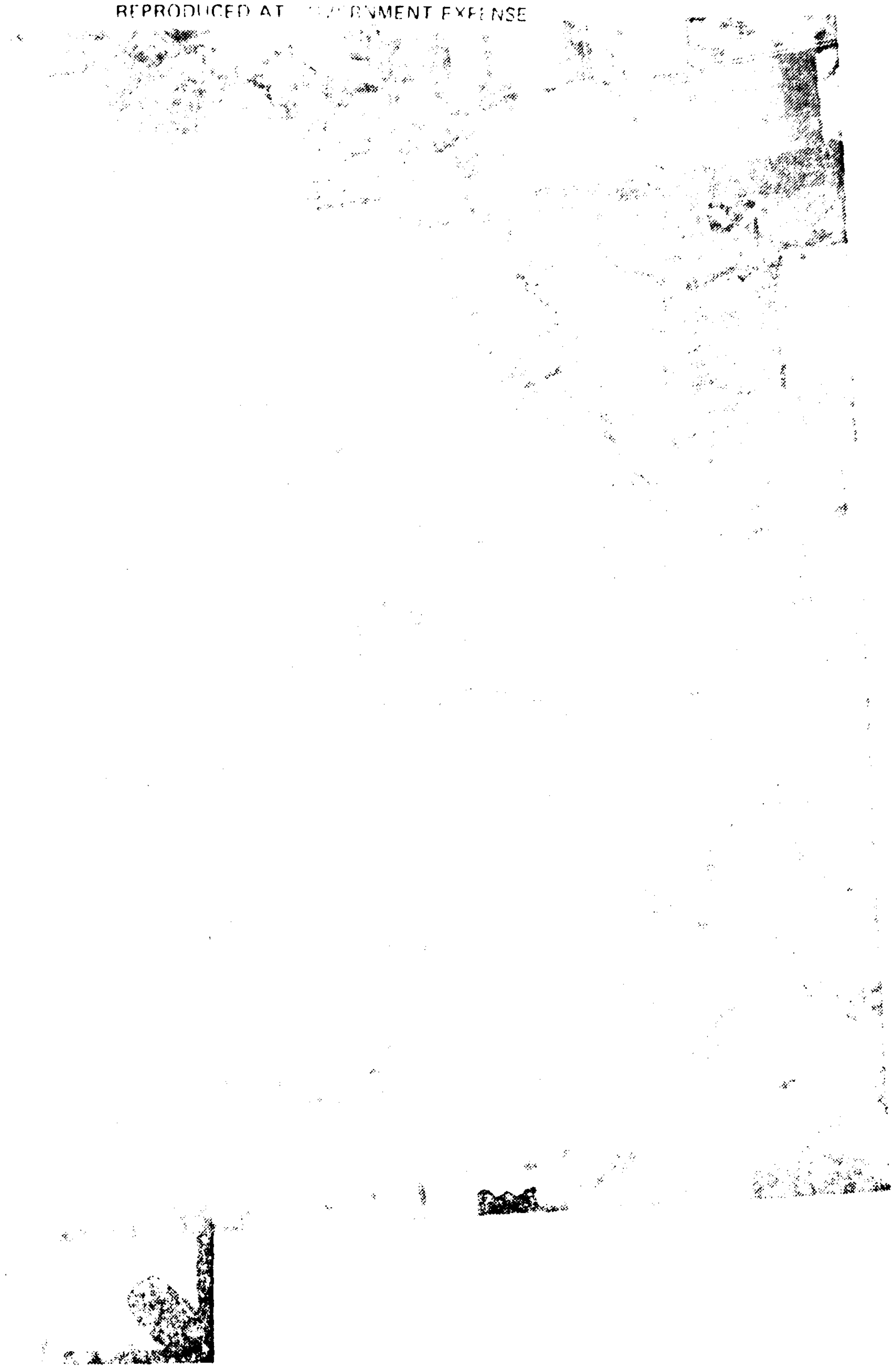


MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 19[illegible]


Hwy 44
James River

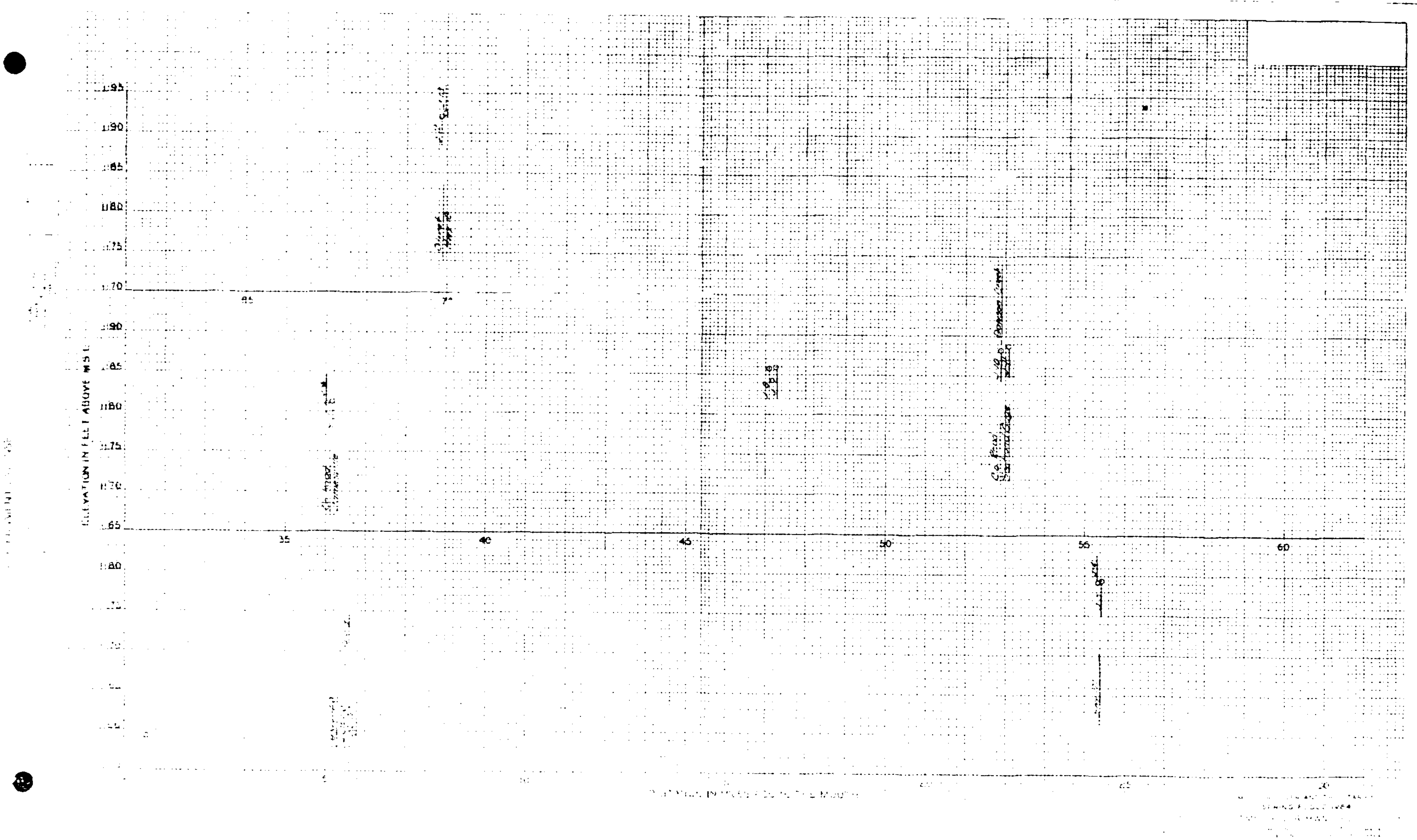


MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT 1984

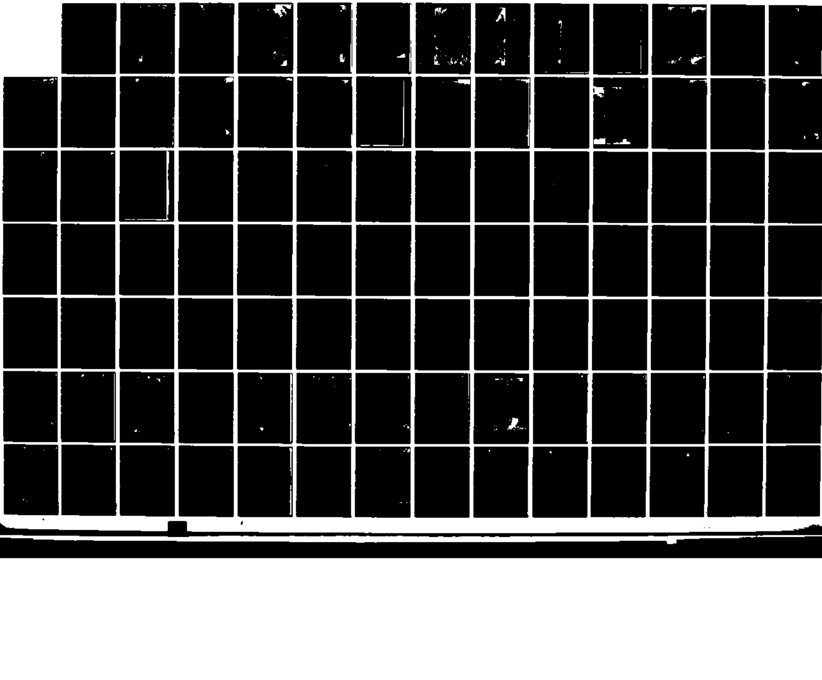
PLATE 24

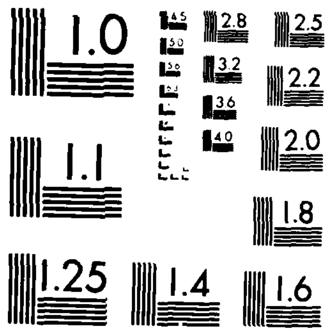

ELEVATION IN FEET ABOVE M.S.L.
1195
1190
1185
1180
1175
1170
1190
1185
1180
1175
1170
1165
1160
65
70
35
40
45
50
55
60


C,M,SP, and P RR
Vermillion River

AD-A149 541 POST-FLOOD REPORT MISSOURI RIVER AND TRIBUTARIES SPRING FLOODS 1984(U) CORPS OF ENGINEERS OMAHA NE OCT 84 2/4

UNCLASSIFIED F/G 8/8 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A


BURBANK

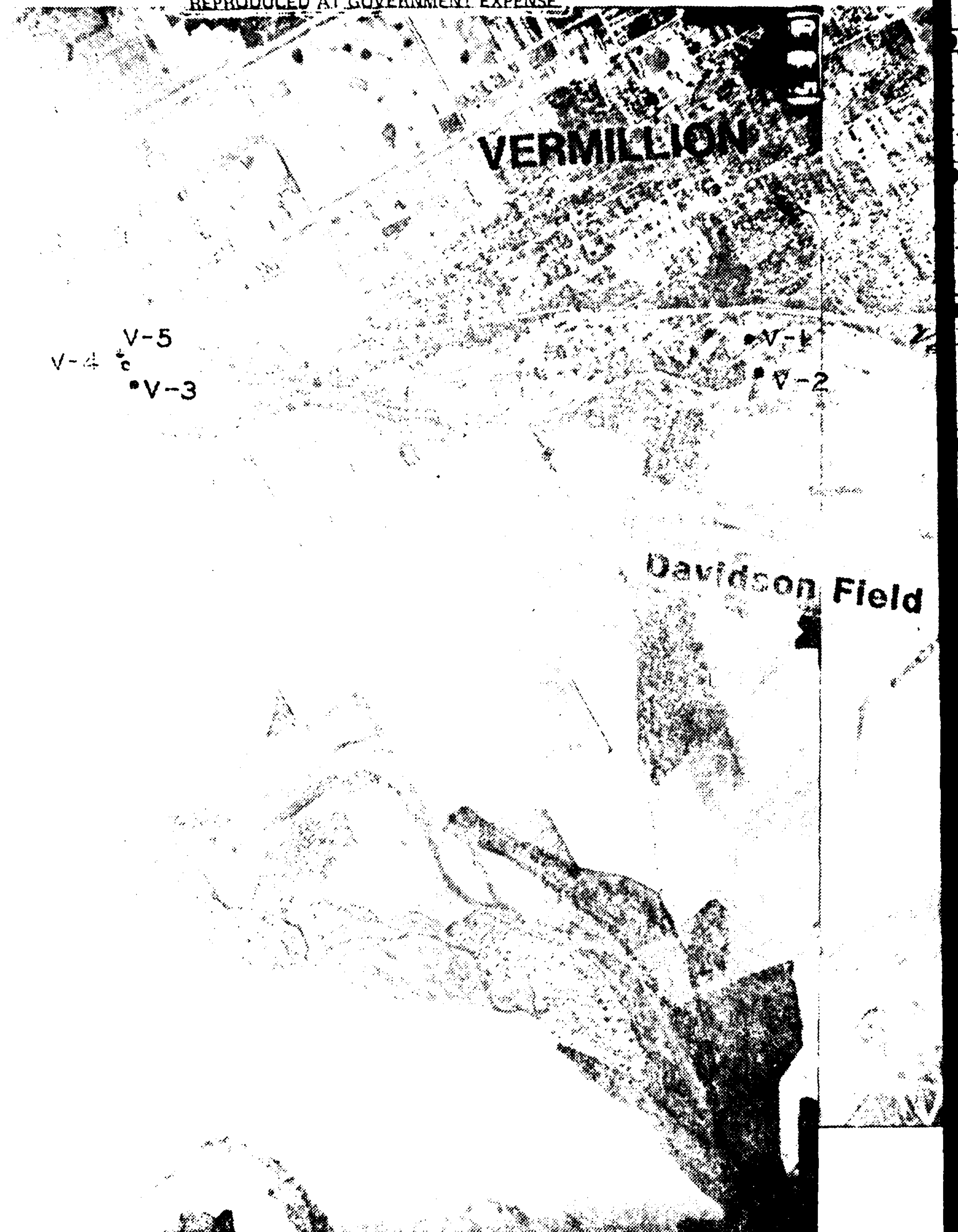
MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

PLATE 26


Clay Creek Ditch
N


VERMILLION
V-5
V-4
V-3
V-1
V-2
Davidson Field

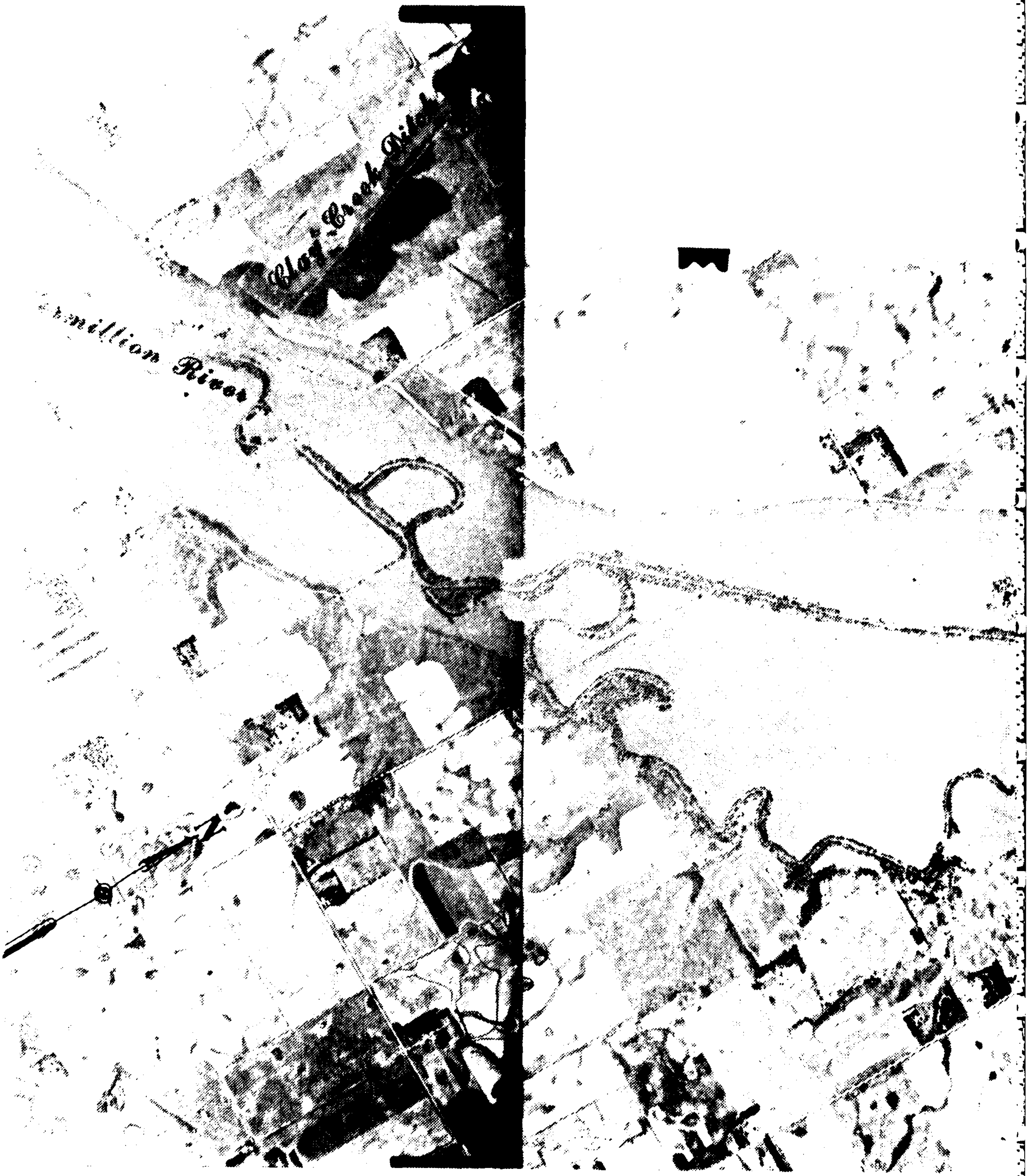
MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

PLATE 27

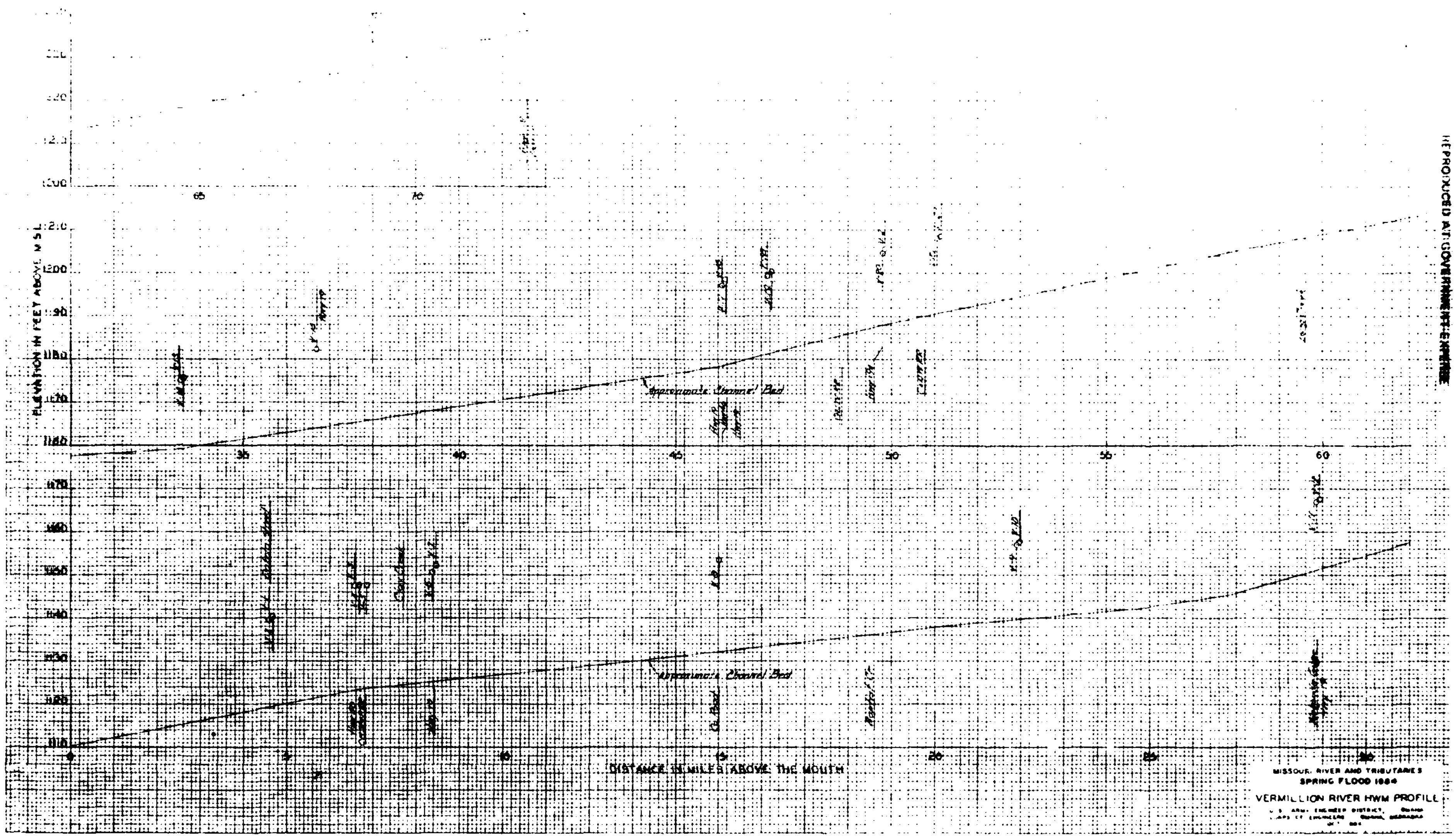

V-6
V-7
Hwy 19



MISSOURI RIVER AND TRIBUTARIES

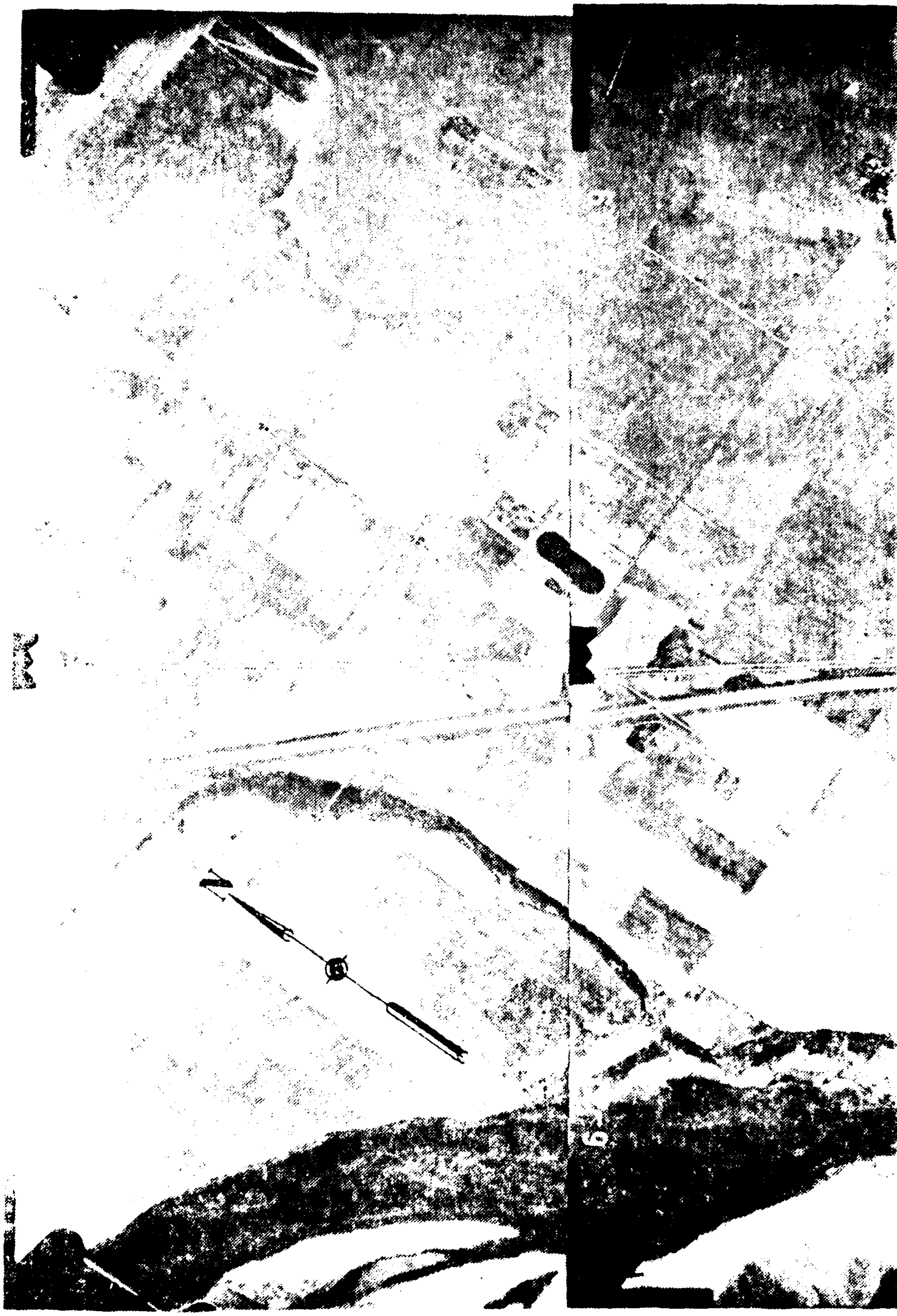
SPRING FLOOD 1984

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

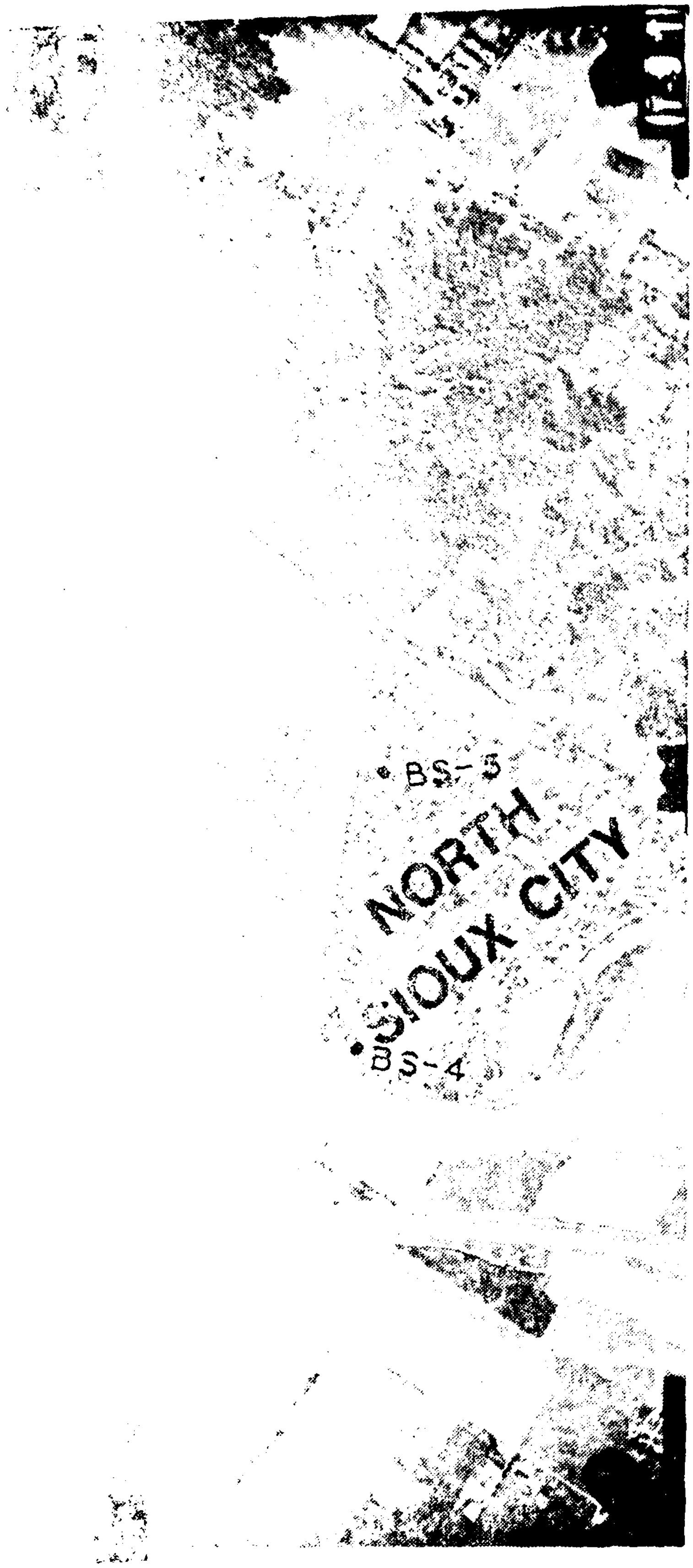


MISSOURI RIVER AND TRIBUTARIES
SPRING FLOOD 1984
VERMILLION RIVER HWM PROFILE

PLATE 29



FS-7.



MISSOURI RIVER AND TRIBUTARIES
SPRING FLOOD 1984
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

PLATE 30


BS-10
Hwy 12


SS-9
SS-8

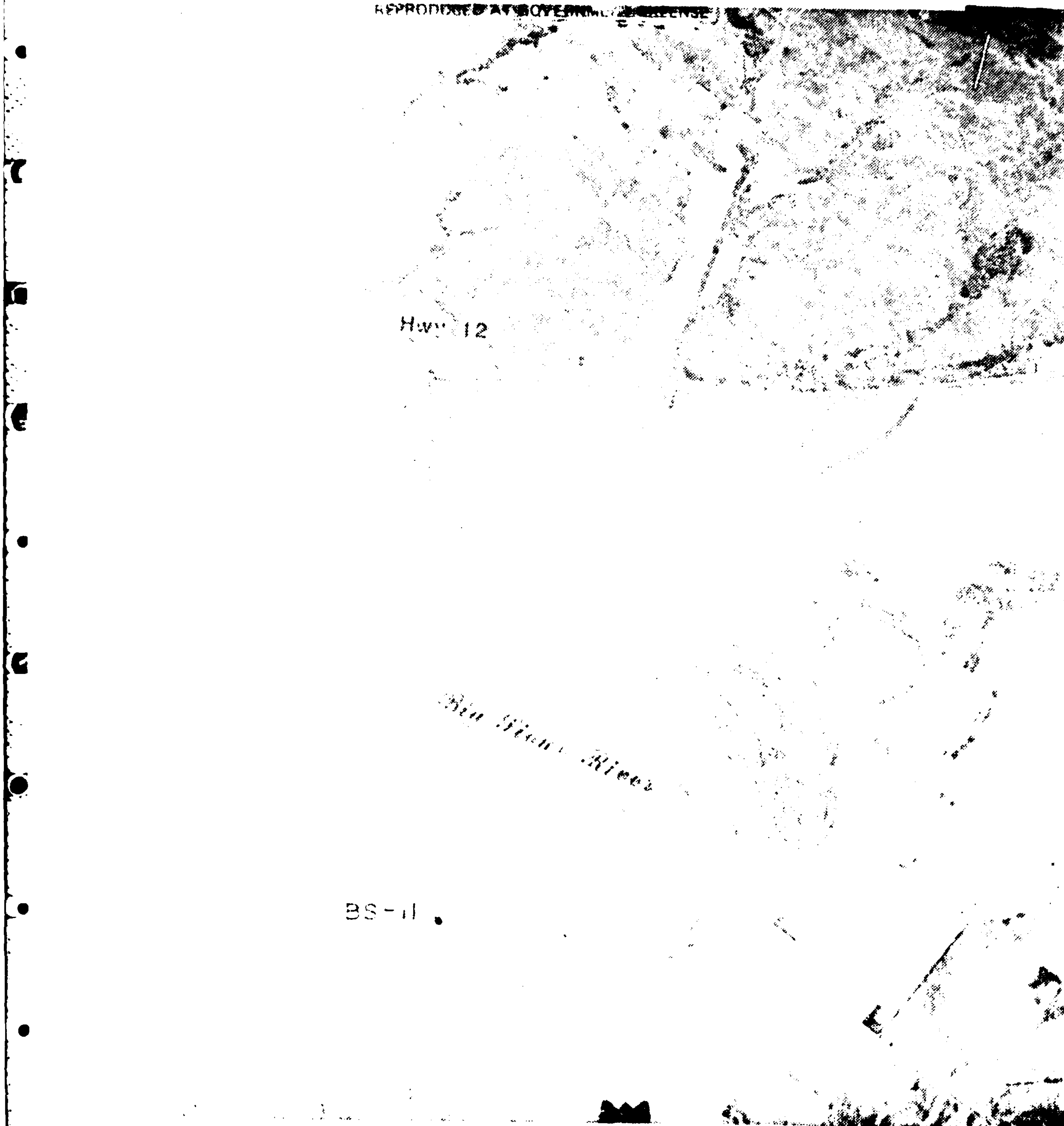
MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

PLATE 31

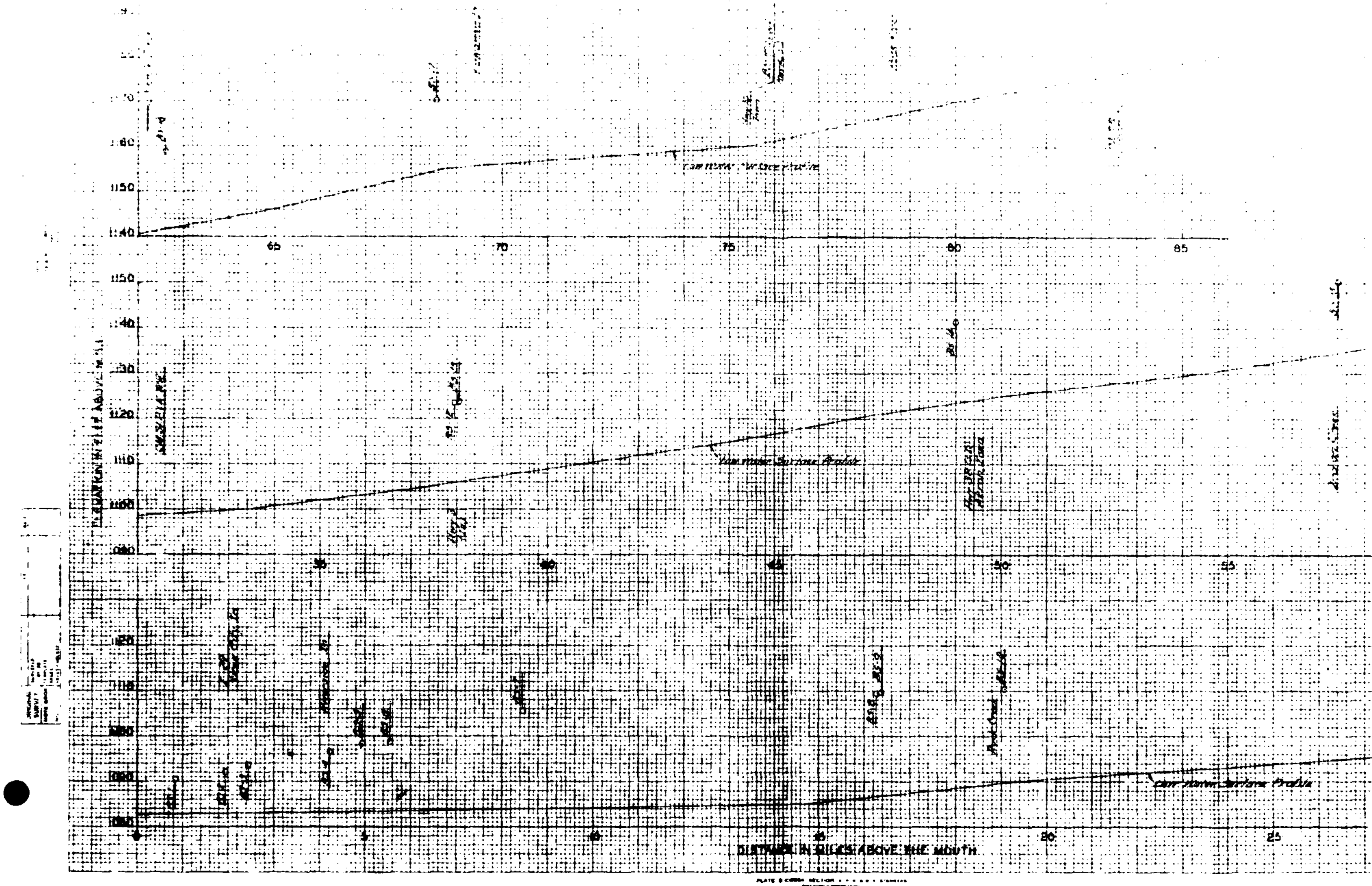

13
BS-12
Brule Creek


Hwy 12
BS-11

MISSOURI RIVER AND TRIBUTARIES

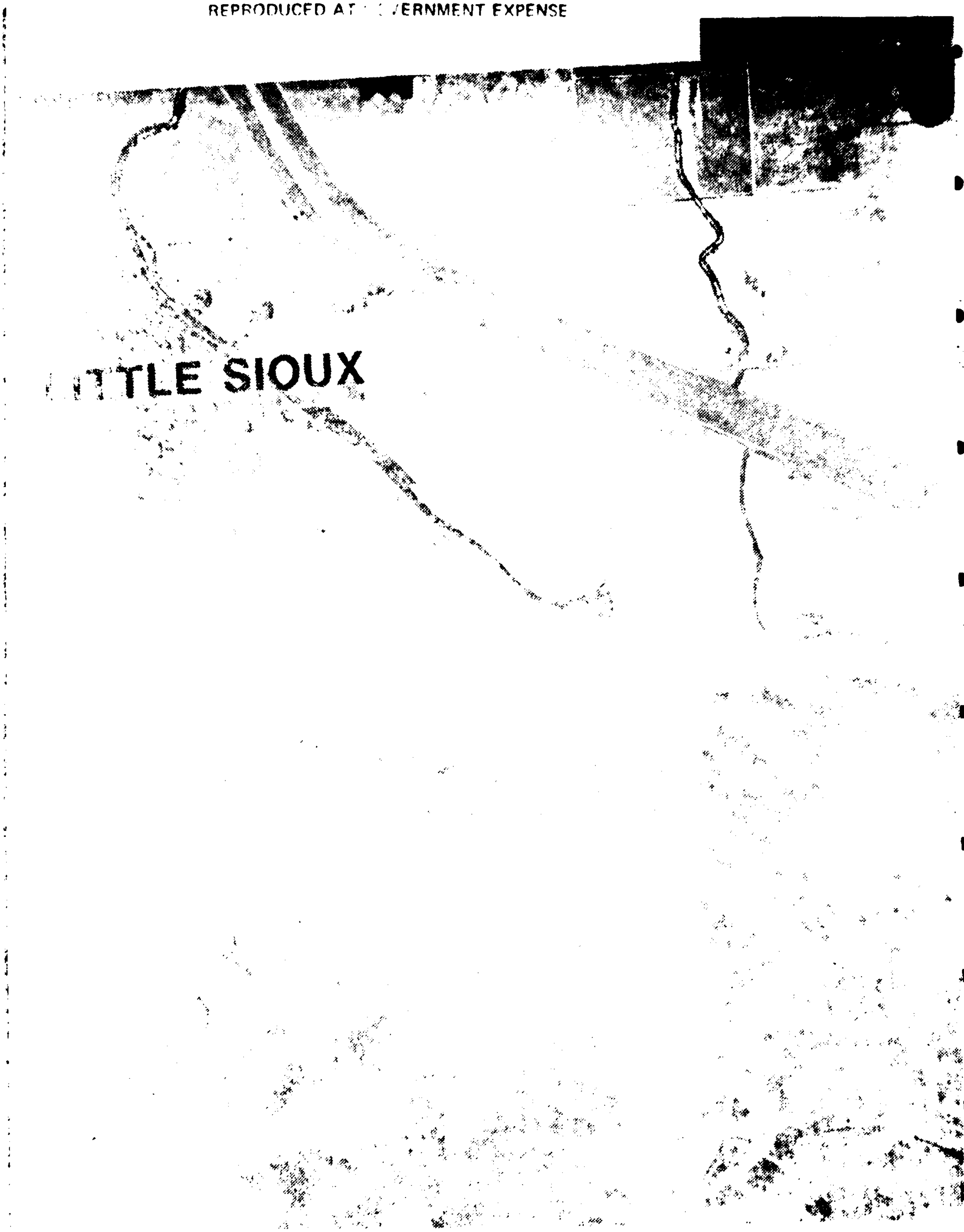
SPRING FLOOD 1984

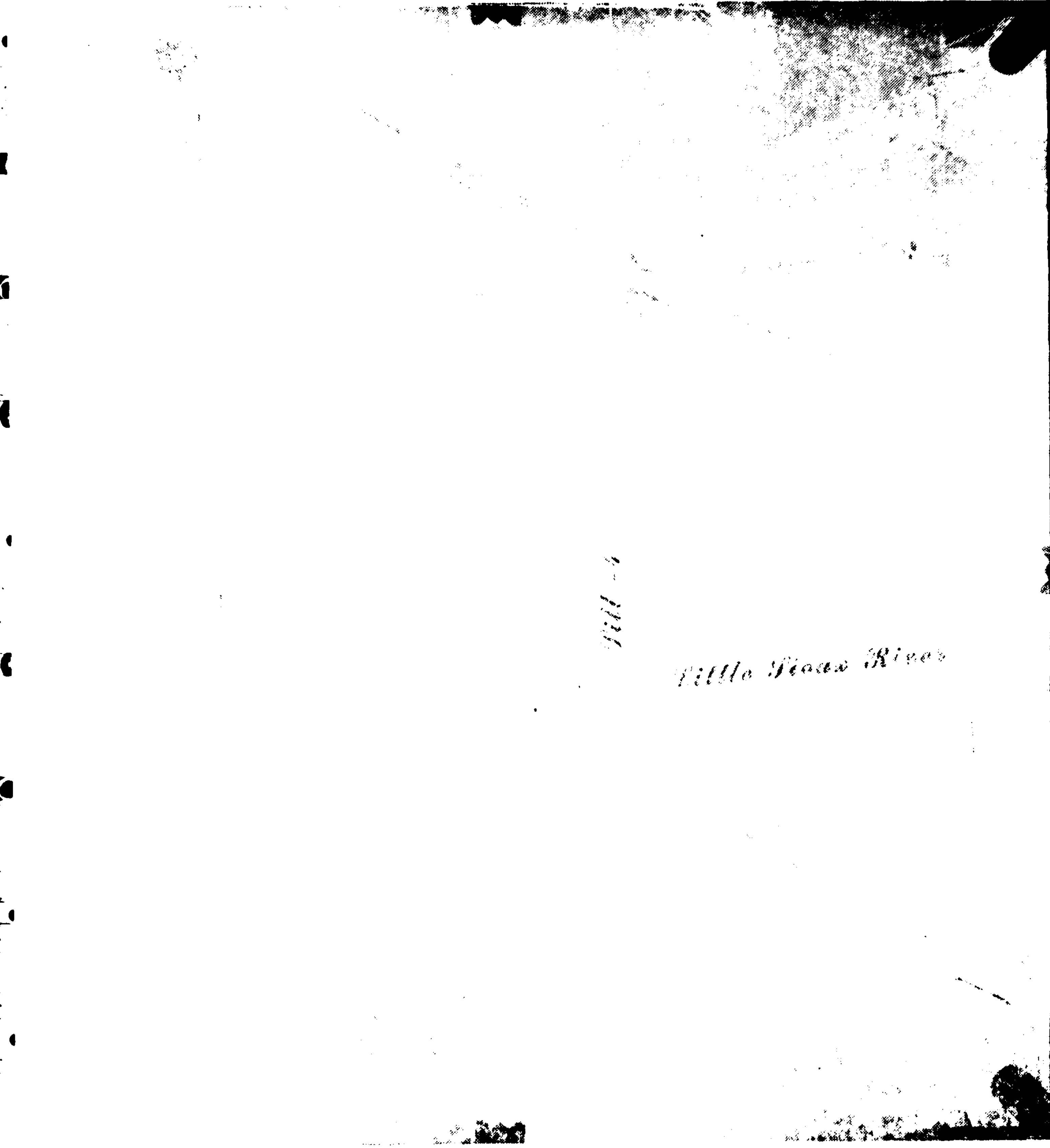
U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

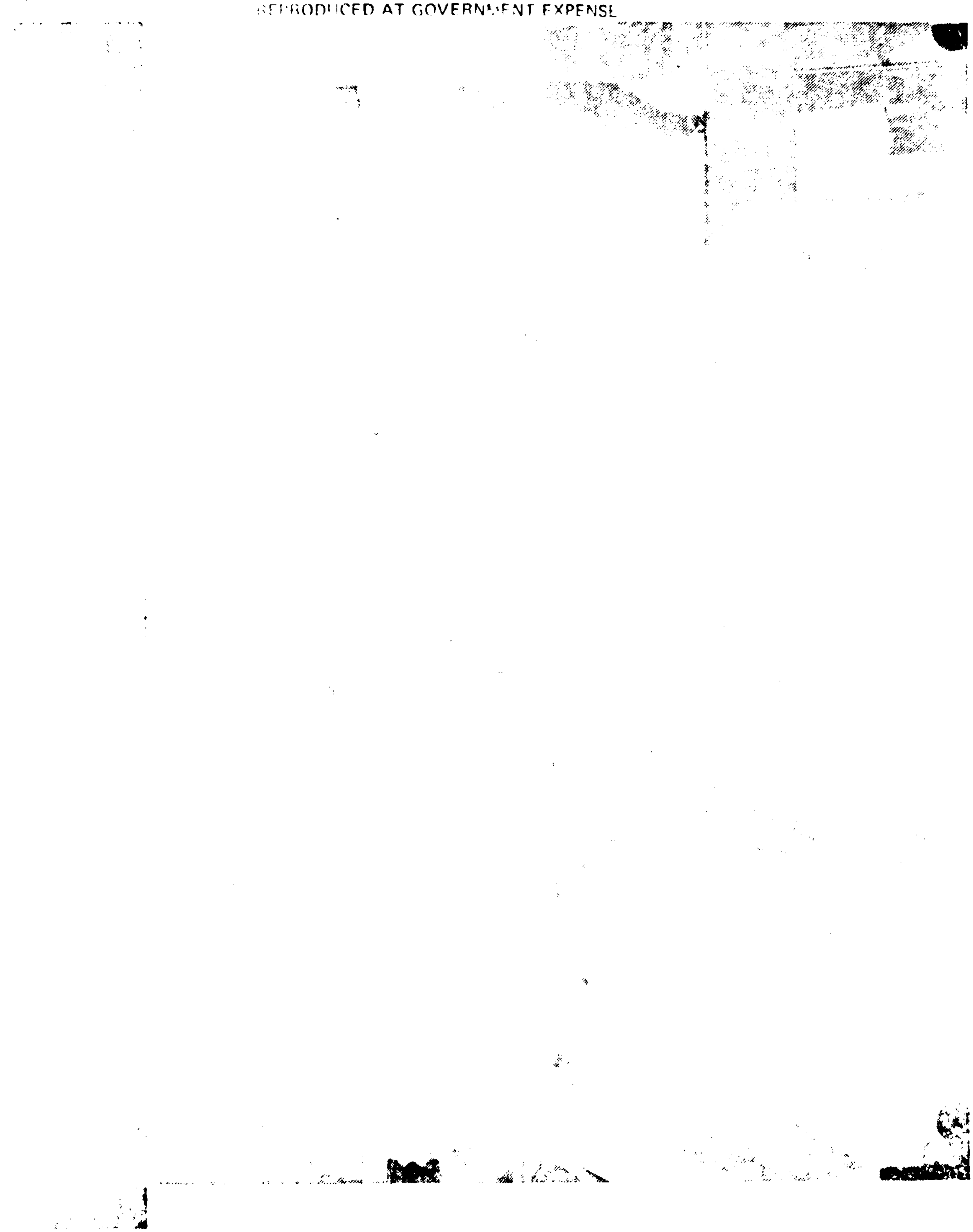


MISSOURI RIVER AND TRIBUTARIES
SPRING FLOOD 1984
BIG SIOUX RIVER HWM PROFILE
U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

PLATE 3


TTLE SIOUX


Little Sioux River



MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

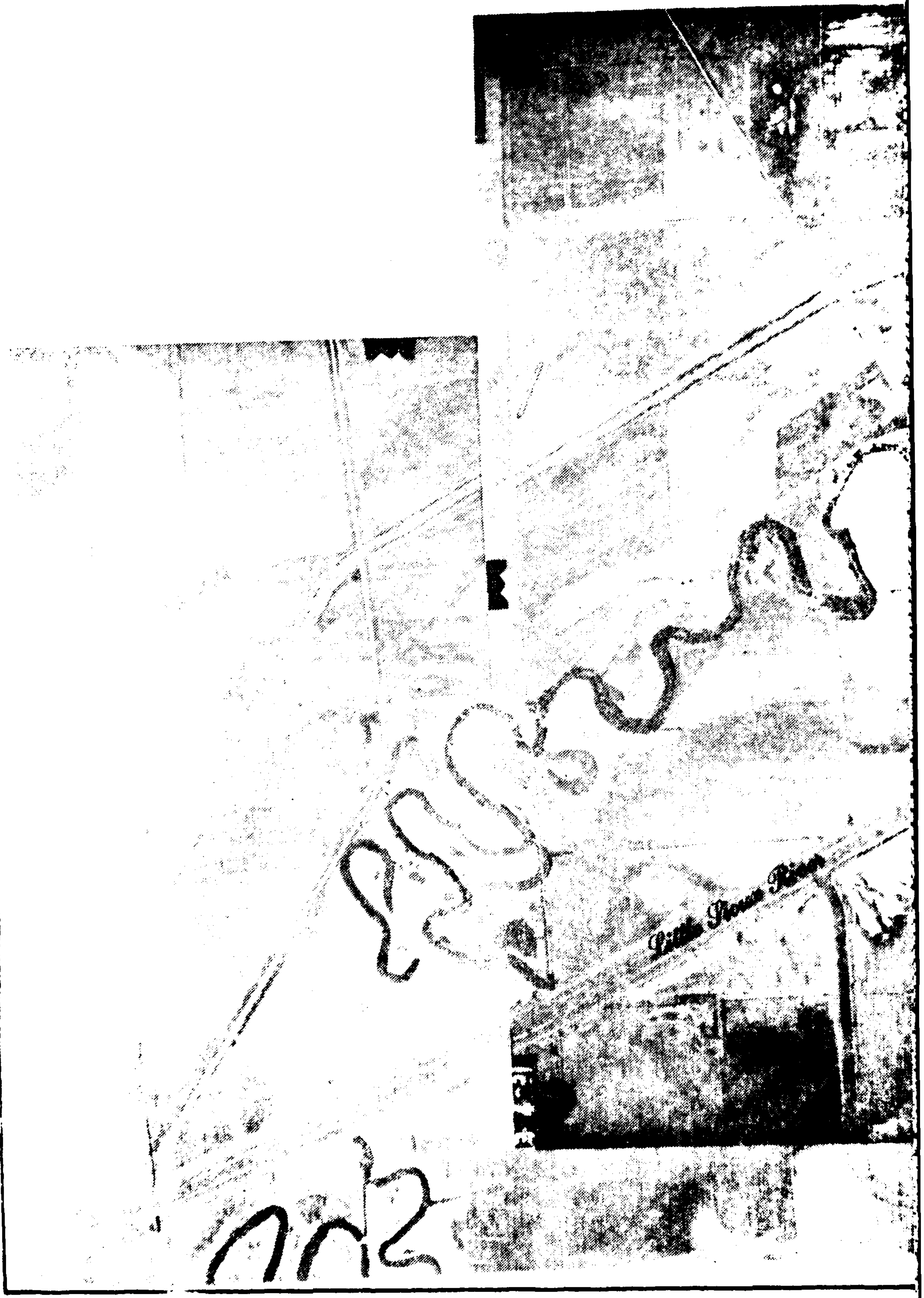
U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

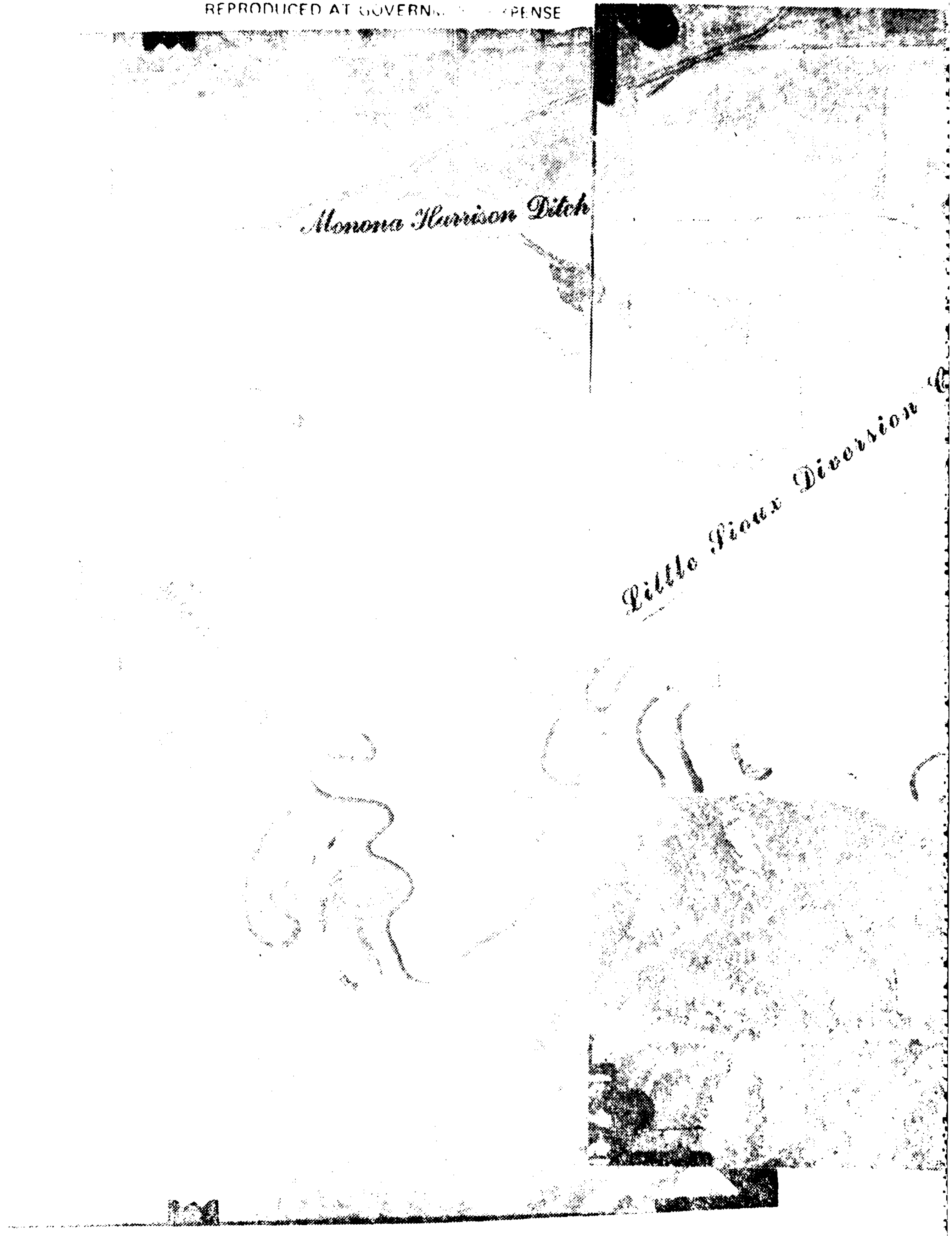
MISSOURI RIVER AND TRIBUTARIES

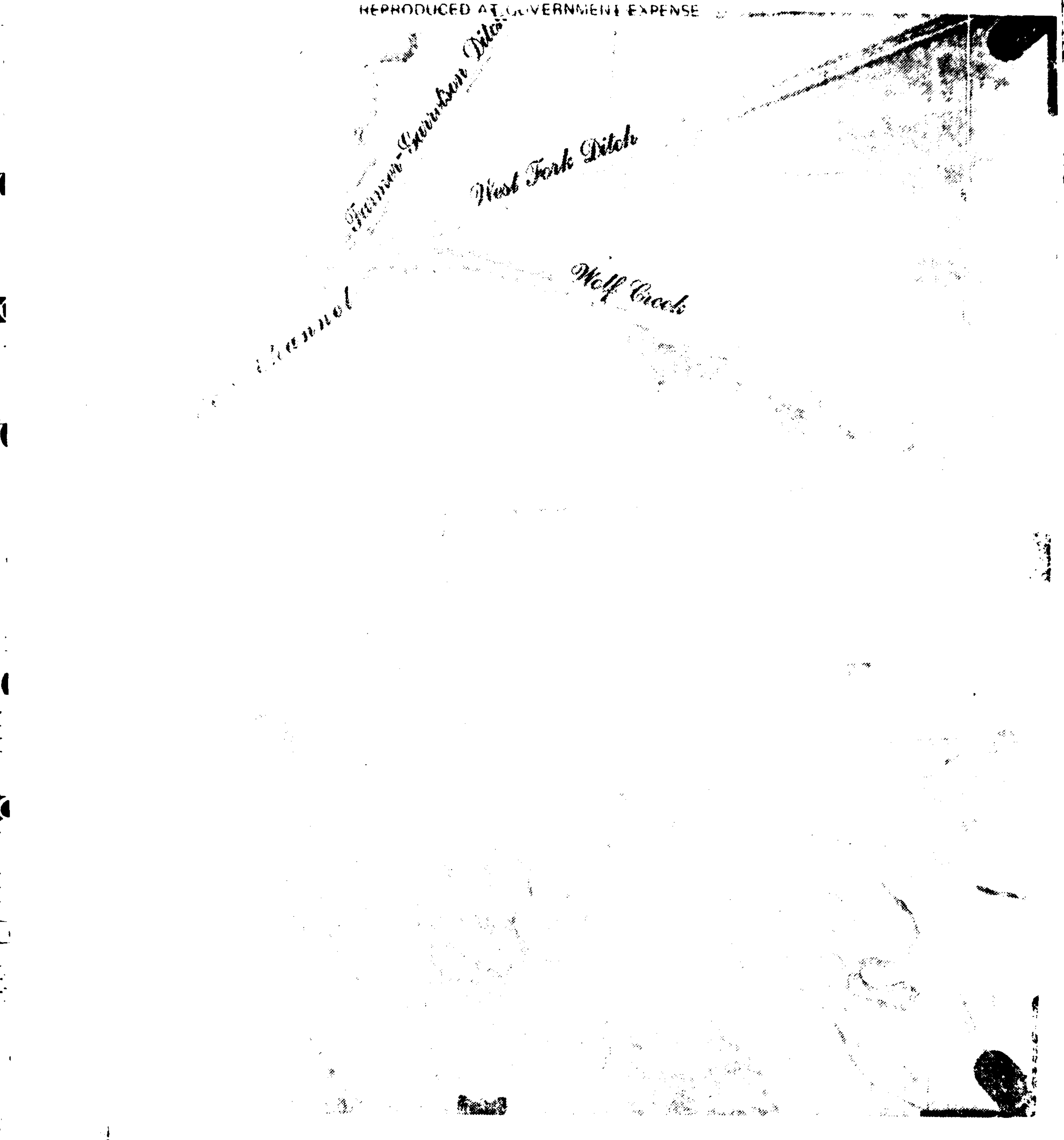
SPRING FLOOD 1984

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

PLATE 55


Little Sioux River


Monona Harrison Ditch
Little Sioux Diversion



MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT 1984

PLATE 30

GLENDO RESERVOIR
1984

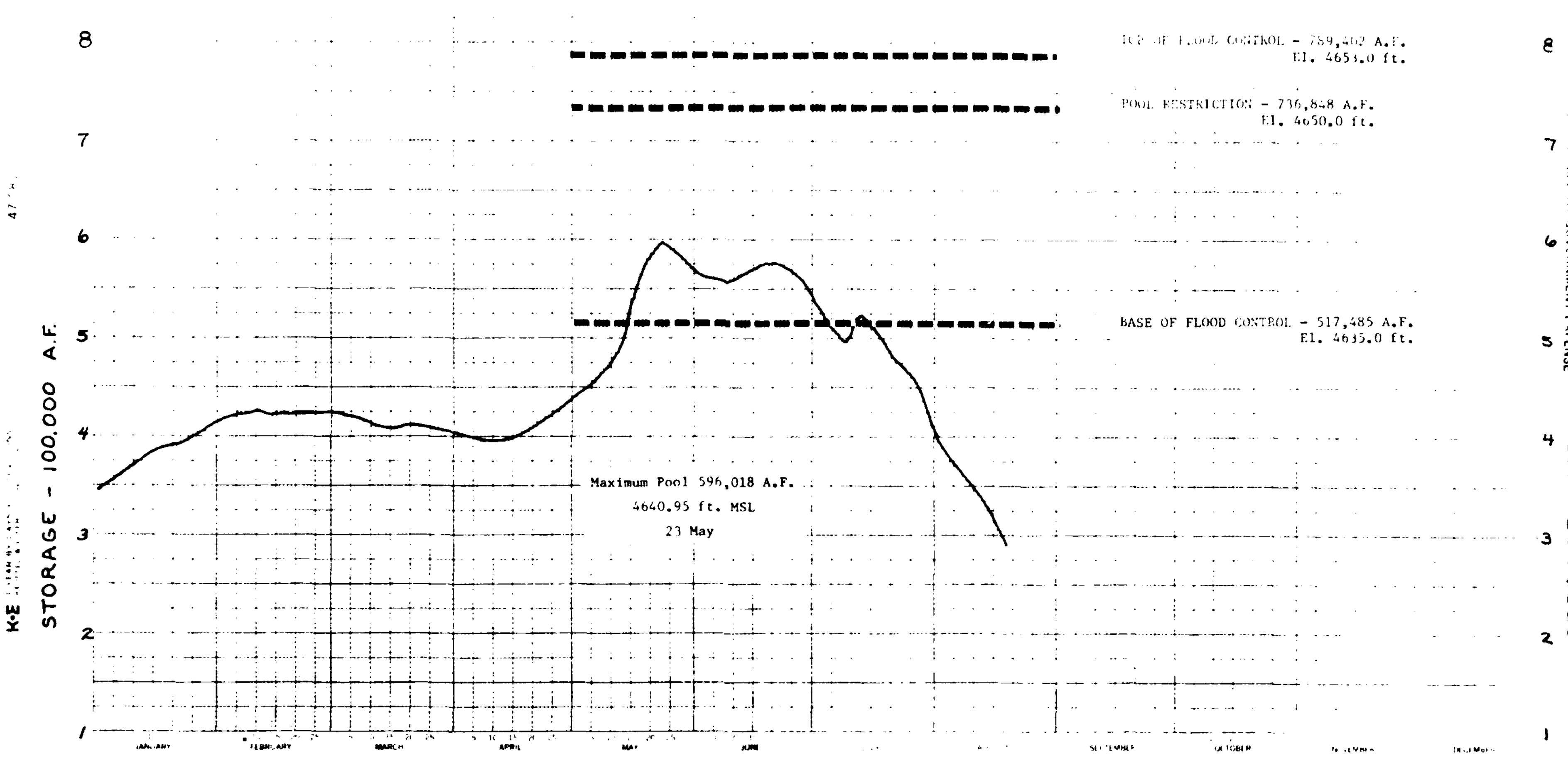


PLATE 37

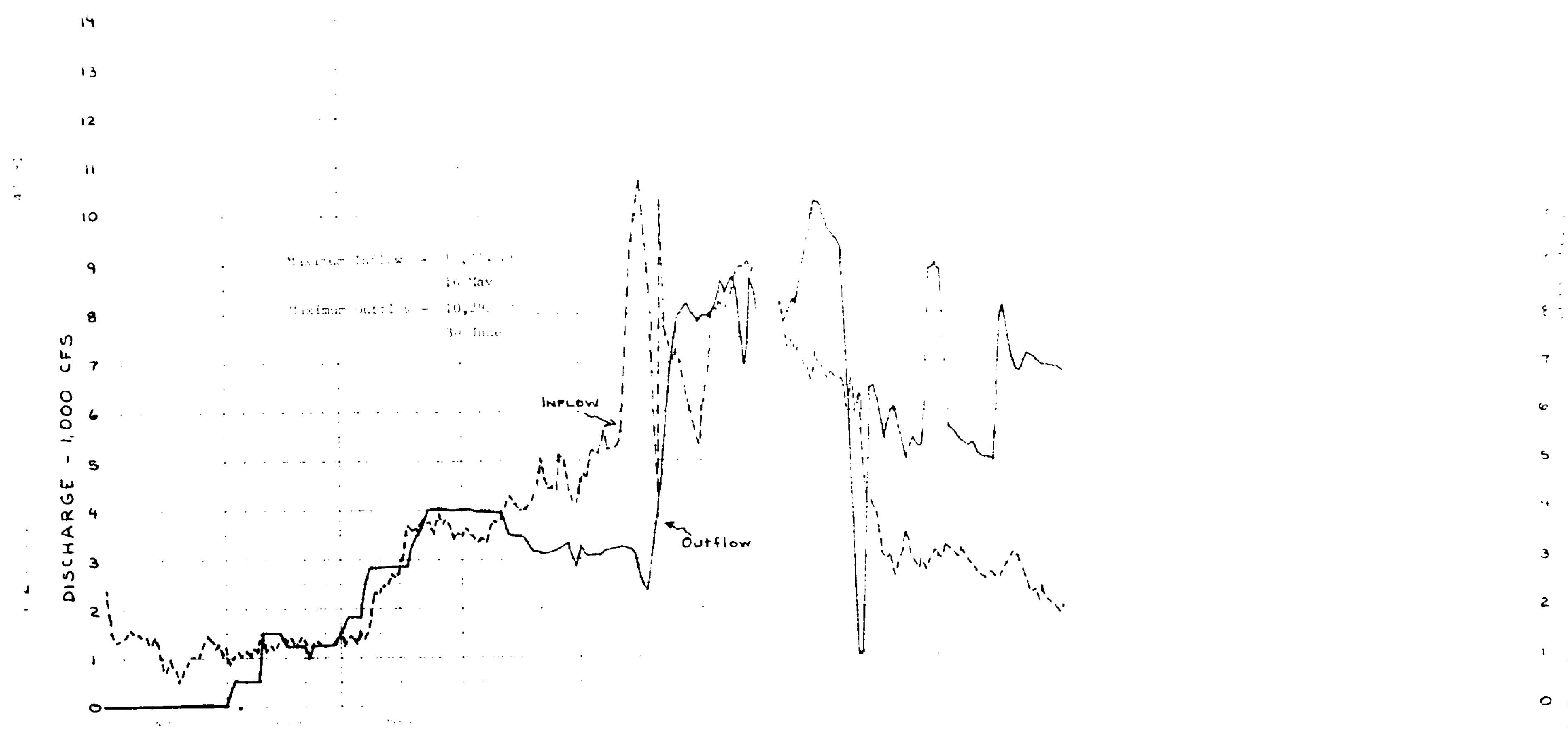

DISCHARGE - 1,000 CFS
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
INFLOW
OUTFLOW
16 May
30 June

PLATE 38

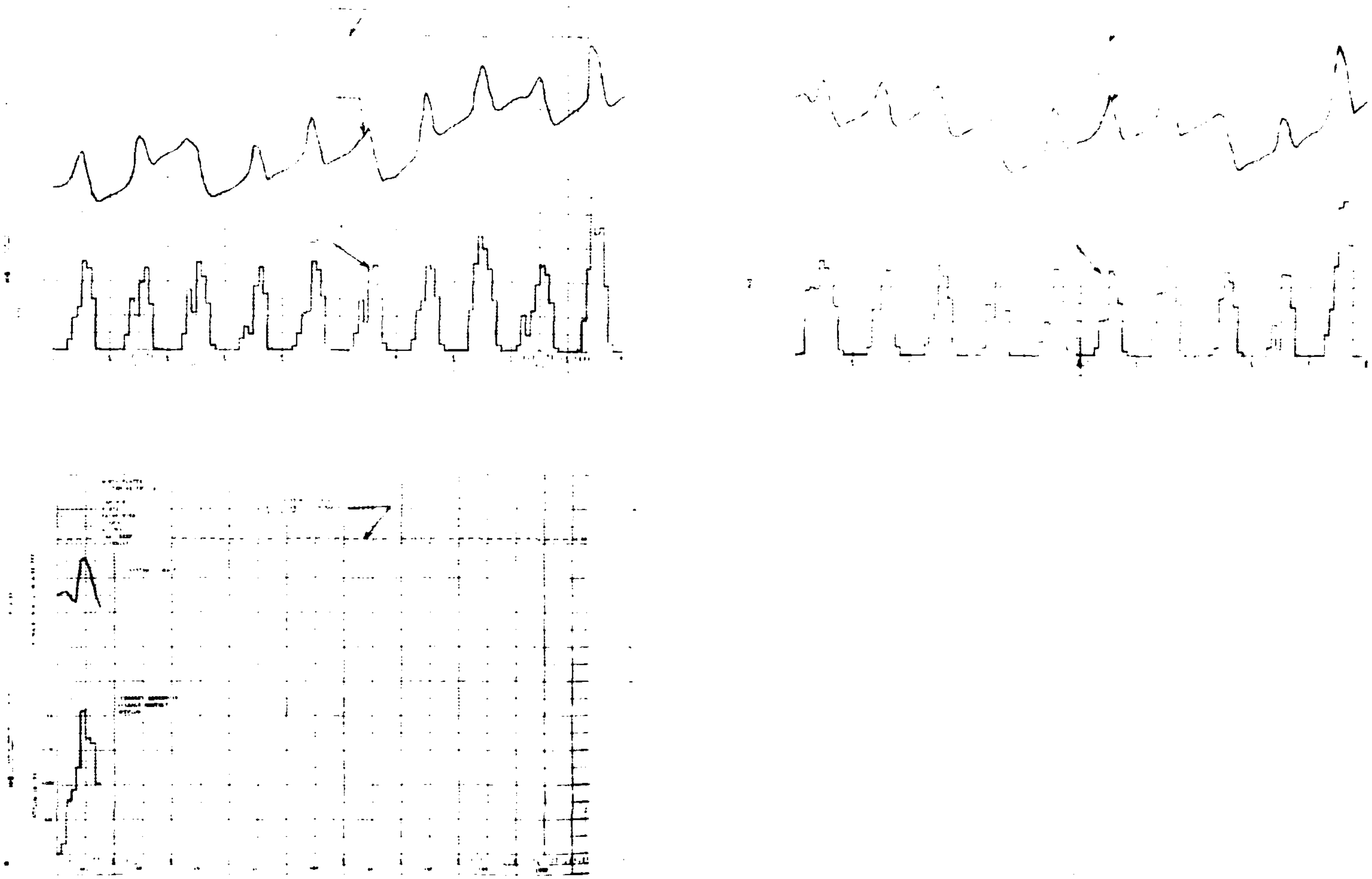


PLATE 3[illegible]

Actual Vs. Natural Streamflow

North Platte River
at Wyoming–Nebraska State Line

1984

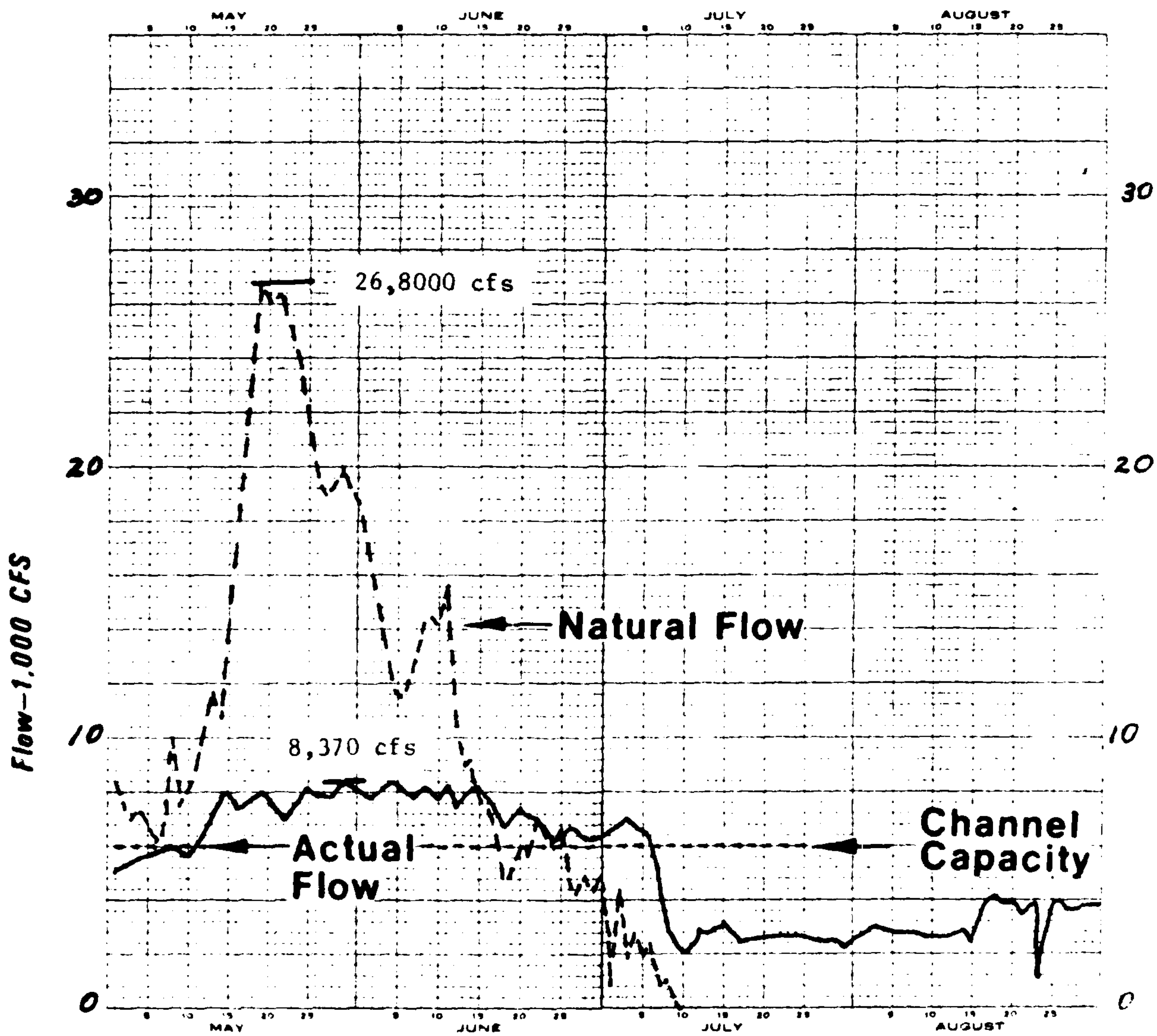


PLATE 40

ITEM NO.	SUBJECT	DAM NO. 2 (OLIVE CREEK LAKE)	DAM NO. 4 (BLUE STEM LAKE)
	GENERAL		
1	Location of dam	1.5 mi. E of Kramer	2.5 mi. W. of Sprague
2	River and mileage	S. Trib. of Olive Br.	N. Trib. of Olive Br.
3	Drainage area in square miles	8.2	16.6
4	Reservoir length in miles	1.2	1.6
5	Location of damtender	none	none
6	Travel time to Lincoln, Nebr.	23 hrs.	13 hrs.
7	Max. discharge of record	-	-
8	Project cost	(1)	(1)
	DAM AND EMBANKMENT		
9	Top of dam - Ft. MSL	1359.0	1334.0
10	Length of dam - Ft.	3020.0	2760.0
11	Height of dam - Ft.	45.0	57.0
12	Stream bed - Ft. MSL	1314.0	1277.0
13	Abutment formation	Clay - sand - silt	Clay - sand
14	Type of fill	Rolled earth	Rolled earth
15	Fill quantity in cubic yds.	312000	471000
16	Date of closure	20 Sep. 1963	12 Sep. 1962
17	Date of initial fill	30 Jun. 1965	6 Jul. 1963
	SPILLWAY		
18	Discharge capacity CFS	15875 at el. 1357.1	22925 at el. 1331.7
19	Crest elevation - Ft. MSL	1350.0	1322.5
20	Width in Ft.	340.0	340.0
21	Gates, number, size, type	Ungated earth channel	Ungated earth channel
	RESERVOIR ELEVATION AND AREA		
22	Maximum pool	1357.1 470A.	1331.7 [illegible]
23	Top of flood control pool	1350.0 356A.	1322.5 [illegible]
24	Top of joint use pool	none	none
25	Top of conservation pool	1335.0 174A.	1307.4 [illegible]
26	Top of sediment pool	1335.0 174A.	1306.1 [illegible]
	STORAGE ZONES - ELEVATION CAPACITY		
27	Surcharge zone	1350.0-1357.1 2910AF	1322.5-1331.7 [illegible]
28	Exclusive flood control zone	1335.0-1350.0 3980AF	1307.4-1322.5 [illegible]
29	Joint use zone	none	none
30	Conservation zone	none	1306.1-1307.4 [illegible]
31	Sediment pool zone	1314.0-1335.0 1490AF	1277.0-1306.1 [illegible]
32	Gross Storage (Excl. of surcharge)	5470 AF	10260 AF
	OUTLET WORKS		
33	No. and size of conduits	1 - CMP - 48" Dia. With 30" RCP lining	1 - CMP - 60" Dia. With 42" RCP lining
34	Conduit Length - Ft.	280	313
35	Gated outlets (No. - size - type)	1 - 36" x 36" Lift gate	1 - 36" x 36" Lift gate
36	Ungated outlets (Openings - size - elev.)	2 - 24" x 72" - 1340.9 2 - 12" x 30" - 1335.0	2 - 30" x 96" - 1313.5 2 - 12" x 54" - 1307.4
37	Disch. capac. - CFS (at base of EFC zone)	80	75
	POWER INSTALLATION	none	none
38	No. and size of turbines		
39	No. and rating of generators		
40	Plant capacity		
41	Pwr Plt disch capac (at base of EFC zone)		

SUMMARY OF ENGINEERING DATA - FEDERAL RESERVOIRS WITH AUTHORIZED FLOOD CONTROL SPACE

MISSOURI RIVER TRIBUTARIES - U.S. ENGINEER DISTRICT - OMAHA

SALT CREEK BASIN - NEBRASKA

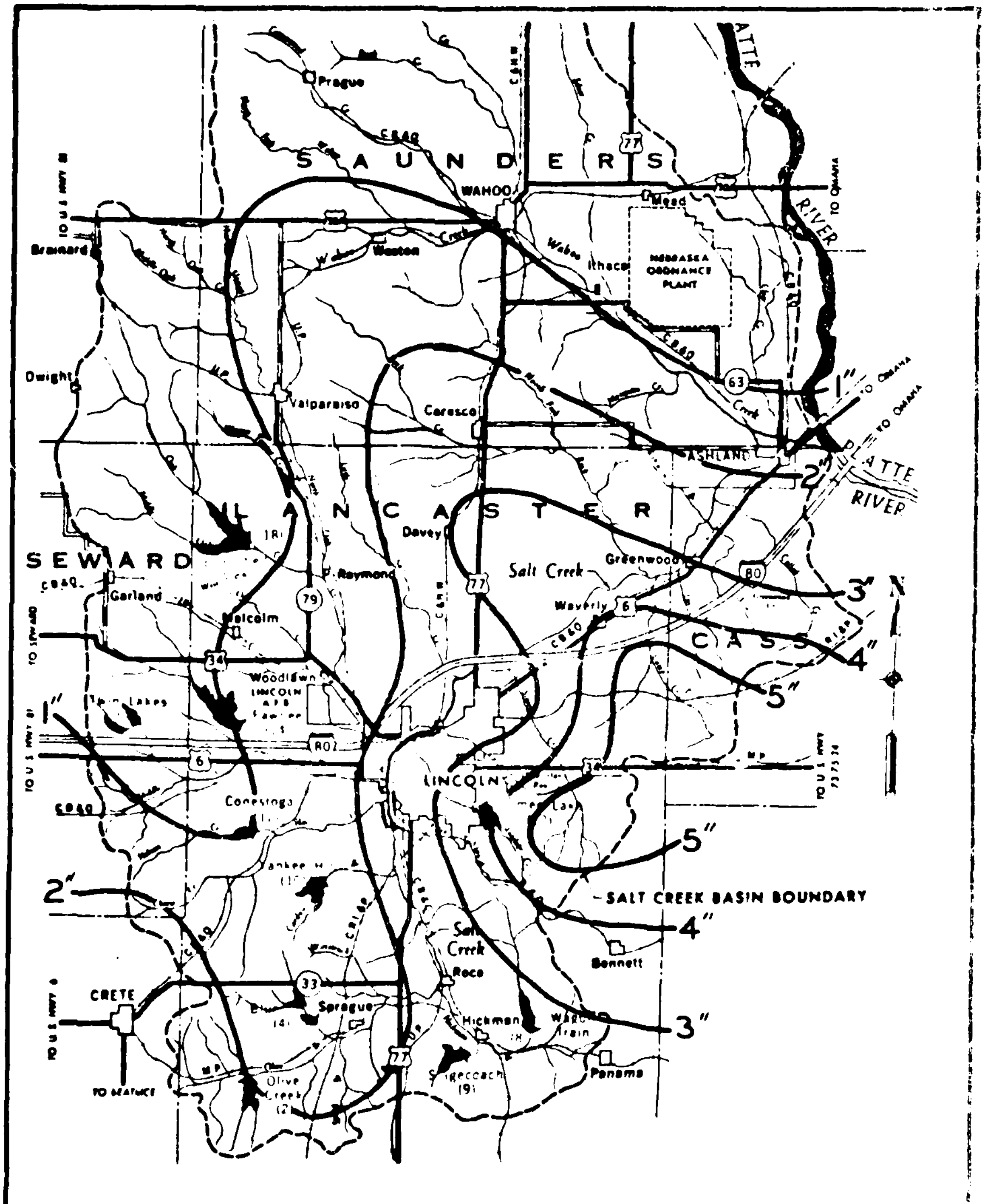
DAM NO. 4 (BLUE STEM LAKE)	DAM NO. 8 (WAGON TRAIN LAKE)	DAM NO 9 (STAGECOACH LAKE)	DAM NO. 10 (YANKEE HILL LAKE)	DAM NO. 12 (CONESTOGA LAKE)
[illegible] N. of Sprague [illegible] of Olive Br. - [illegible] none [illegible]rs. -	1.5 mi. N. of Holland N. Trib. of Hickman Br. - 15.6 1.8 none 14 hrs. - (1)	1 mi. S. of Hickman S. Trib. of Hickman Br. - 9.7 1.4 none 8 hrs. - (1)	3.5 mi. E. of Denton Cardwell Br. - 8.4 0.7 none 3 hrs. - (1)	1.5 mi. N. of Denton Holmes Cr. - 15.1 1.4 none 8 hrs. - (1)
[illegible] [illegible] [illegible] [illegible].0 [illegible] sand [illegible] earth [illegible] Sep. 1962 [illegible] 1963	1312.0 1650.0 52.0 1260.0 Clay Rolled earth 376000 24 Sep. 1962 24 Jun. 1963	1294.0 2250.0 48.0 1246.0 Clay - sand Rolled earth 374000 27 Aug. 1963 25 May 1965	1270.0 3100.0 52.0 1218.0 Clay - sand Rolled earth 502000 5 Oct. 1965 10 Jun. 1967	1260.0 3000.0 63.0 1197.0 Clay - sand Rolled earth 658000 24 Sep. 1963 May 1965
[illegible]5 at el. 1331.7 [illegible] [illegible] [illegible] earth channel	23210 at el. 1309.8 1302.0 430.0 Ungated earth channel	17565 at el. 1291.6 1285.0 430.0 Ungated earth channel	12100 at el. 1267.8 1262.0 400.0 Ungated earth channel	27220 at el. 1258.2 1252.0 750.0 Ungated earth channel
[illegible].7 995A. [illegible].5 660A. none [illegible].4 315A. [illegible].1 290A.	1309.8 875A. 1302.0 660A. none 1287.8 303A. 1284.6 225A.	1291.6 645A. 1285.0 490A. none 1271.1 196A. 1271.1 196A.	1267.8 620A. 1262.0 475A. none 1244.9 208A. 1241.9 175A.	1258.2 755A. 1252.0 620A. none 1232.9 230A. 1232.9 230A.
[illegible].5-1331.7 9420AF [illegible].4-1322.5 7220AF none [illegible]-1307.4 380AF [illegible]-1306.1 2660AF [illegible] AF	1302.0-1309.8 5990AF 1287.8-1302.0 6790AF none 1284.6-1287.8 830AF 1260.0-1284.6 1660AF 9280 AF	1285.0-1291.6 3725AF 1271.1-1285.0 4700AF none none 1246.0-1271.1 194CAF 6640 AF	1262.0-1267.8 3150AF 1244.9-1262.0 5560AF none 1241.9-1244.9 570AF 1218.0-1241.9 1430AF 7560 AF	1252.0-1258.2 4245AF 1232.9-1252.0 8030AF none none 1197.0-1232.9 2610AF 10640 AF
[illegible] 60" Dia [illegible] RCP lining [illegible] [illegible] Lift gate [illegible] [illegible]	1 - CMP - 60" Dia With 42" RCP lining 299 1 - 36" x 36" Lift gate 2 - 30" x 96" - 1292 4 2 12" x 54" - 1287 8 75	1 - CMP - 48" Dia With 30" RCP lining 280 1 - 36" x 36" Lift gate 2 - 24" x 72" - 1277 1 2 - 12" x 30" - 1271 1 80	1 - CMP - 42" Dia With 30" RCP lining 300 1 - 36" x 36" Lift gate 2 - 18" x 63" - 1250 0 2 - 12" x 30" - 1244 9 95	1 - CMP - 60" Dia With 42" RCP lining 318 1 - 36" x 36" Lift gate 2 - 30" x 96" - 1242 3 2 - 12" x 54" - 1232 9 80
none	none	none	none	none

(1) Total project financial cost including all dams = $12,075,000 (Costs are as of 9-30-80)

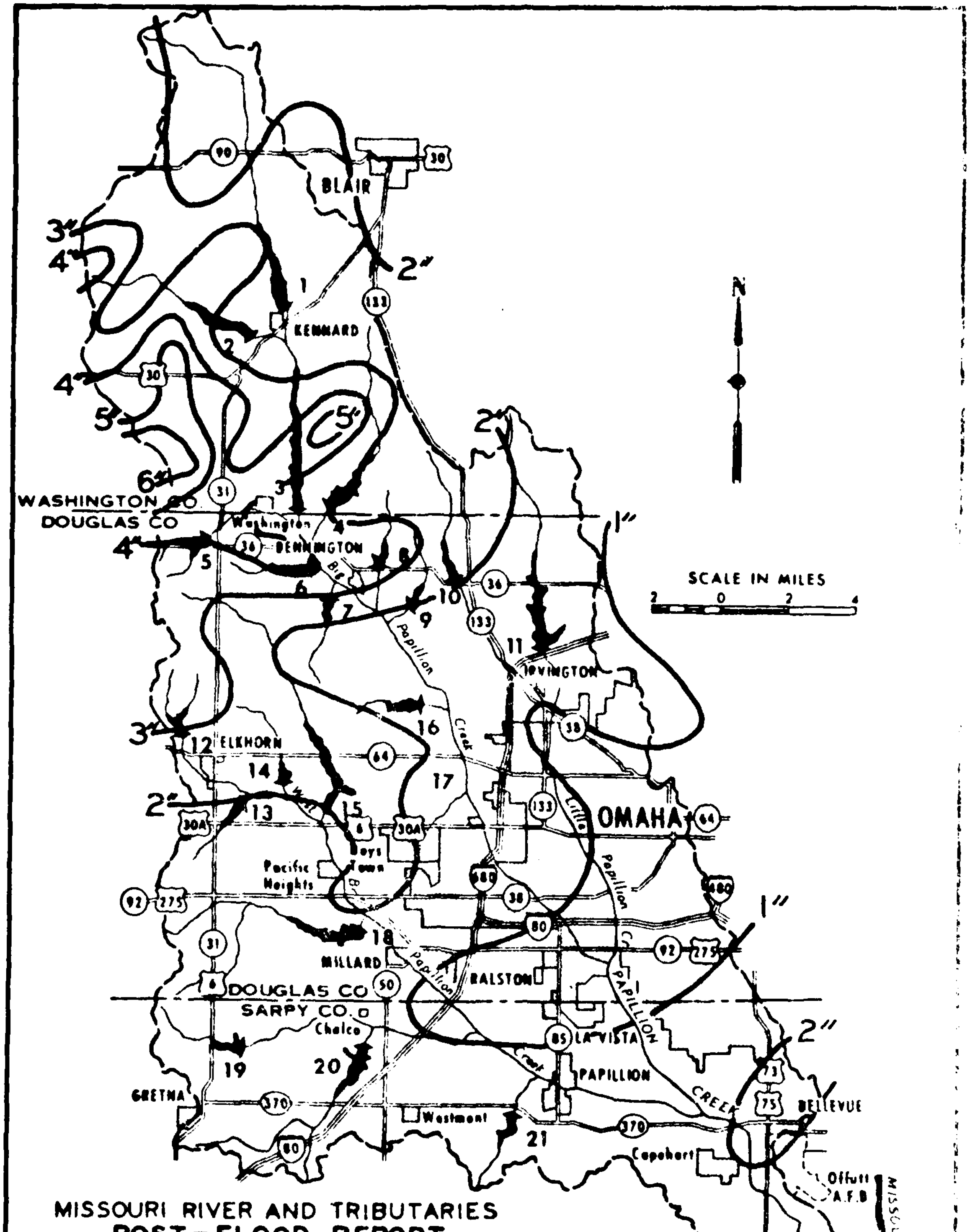
D CONTROL SPACE

HA

DAM NO. 12 (CONESTOGA LAKE)	DAM NO. 13 (TWIN LAKES)	DAM NO. 14 (PAWNEE LAKE)	DAM NO. 17 (HOLMES PARK LAKE)	DAM NO. 18 (BRANCHED OAK LAKE)
... of Denton Cr. - none	2 mi. NW. of Pleasantdale Middle Cr. - 11.0 1.5 none 13 hrs. - (1)	2 mi. NW. of Emerald N. Middle Cr. - 35.9 3.0 none 7 hrs. - (1)	SE. edge of Lincoln Antelope Cr. - 5.4 0.7 none 3 hrs. - (1)	4 mi. W. of Raymond Oak Cr. 88.7 3.7 none 6 hrs. - (1)
	1364.0 2075.0 58.0 1306.0 Clay - sand - silt Rolled earth 610000 26 Sep. 1965 18 Mar. 1969	1271.0 5000.0 65.0 1206.0 Clay - sand Rolled earth 870000 16 Jul. 1964 21 Jun. 1967	1273.0 7700.0 55.0 1218.0 Clay - sand Rolled earth 900000 17 Sep. 1962 2 Jun. 1965	1320.0 5200.0 70.0 1250.0 Clay - sand - silt Rolled earth 2460000 21 Aug. 1967 18 Jan 1973
1258.2 channel	25200 at el. 1361.6 1353.0 400.0 Ungated earth channel	19875 at el. 1269.1 1263.5 700.0 Ungated earth channel	800 at el. 1269.7 1266.0 50.0 Ungated earth channel	7825 at el. 1317.5 1311.0 200.0 Ungated earth channel
755A. 620A. none 230A. 230A.	1361.6 645A 1355.0 505A none 1341.0 255A 1337.4 205A	1269.1 1780A. 1263.5 1470A. none 1244.3 728A. 1244.3 728A.	1269.7 470A. 1266.0 410A. none 1242.5 100A. 1240.0 75A.	1317.3 4207A. 1311.0 3640. none 1284.0 1780A. 1275.7 1270A.
4245AF 8030AF none none 2.9 2610AF	1355.0-1361.6 3790AF 1341.0-1355.0 5250AF none 1337.4-1341.0 810AF 1306.0-1337.4 2020AF 8080 AF	1263.5-1269.1 9060AF 1244.3-1263.5 21010 AF none none 1206.0-1244.3 8510AF 29520 AF	1266.0-1269.7 3270AF 1242.4-1266.0 5730AF none 1240.0-1242.4 210AF 1218.0-1240.0 570AF 6510 AF	1311.0-1317.3 24720AF 1284.0-1311.0 71570AF none 1275.7-1284.0 12740AF 1250.0-1275.7 13250AF 97560 AF
Dia lining Lift gate 1242.3 1232.9	1 - CMP - 42" Dia With 30" RCP lining 335 1 - 42" x 54" Lift gate 2 - 24" x 63" - 1341.0 - 145	1 - CMP - 60" Dia With 42" RCP lining 382 1 - 42" x 60" Lift gate 2 - 34" x 120" - 1244.3 - 210	1 - CMP - 60" Dia With ... lining 3.. 1 - 36" x 36" Lift gate 2 - 30" x 96" - 1249.0 2 - 12" x 36" - 1242.5 60	1 - CMP - concrete Lined - 72" Dia. 370 1 - 48" X 72" Lift gate 2 - 42" X 144" - 1284.0 - 300
none	none	none	none	none

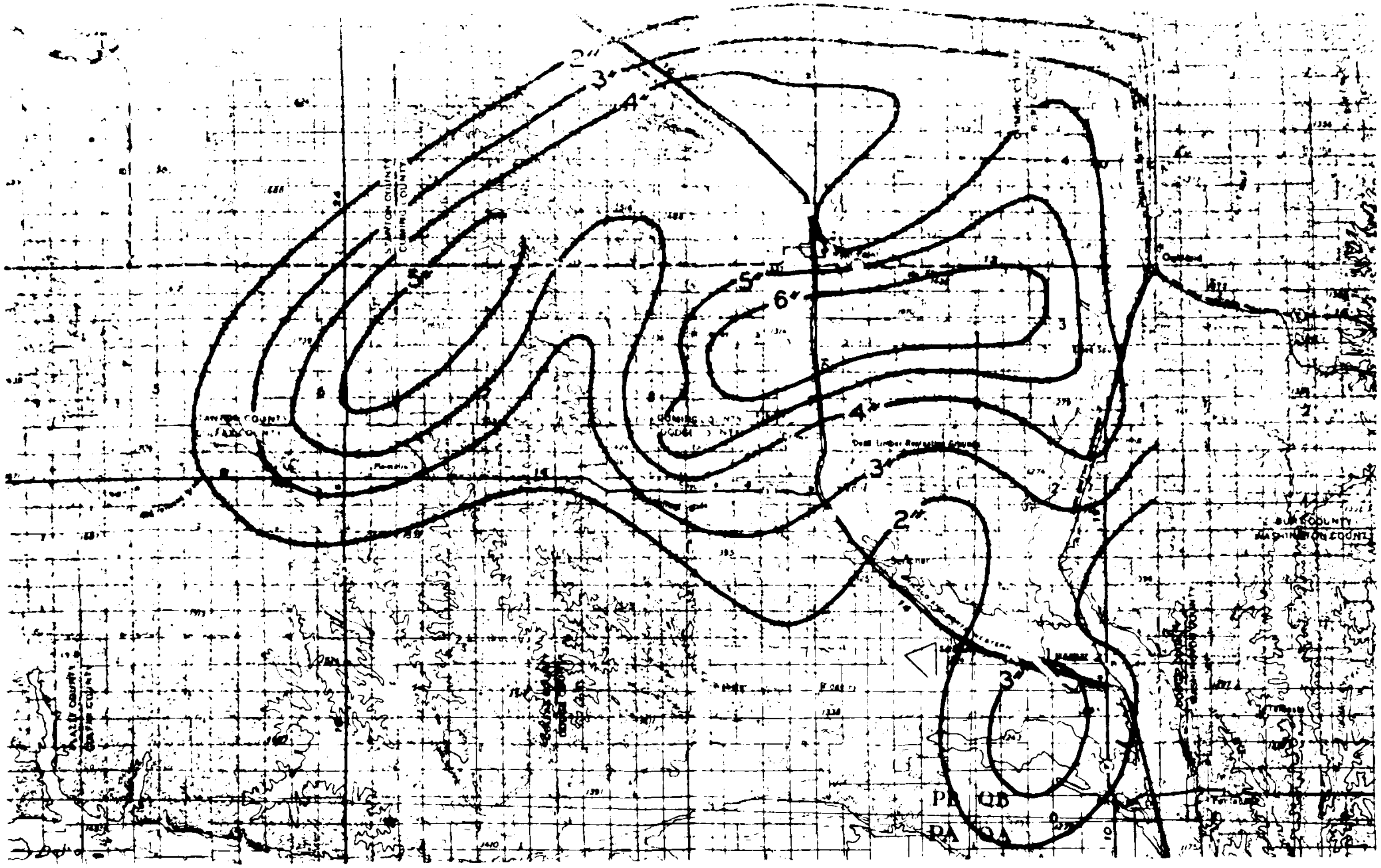


MISSOURI RIVER AND TRIBUTARIES
POST-FLOOD REPORT
SPRING FLOODS 1984
SALT CREEK BASIN
STORM OF 12-13 JUNE 1984
ISOHYETAL STORM PATTERN
U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA



MISSOURI RIVER AND TRIBUTARIES
POST-FLOOD REPORT
SPRING FLOODS 1984
PAPILLION CREEK BASIN
STORM OF 14 JUNE 1984
ISOHYETAL STORM PATTERN

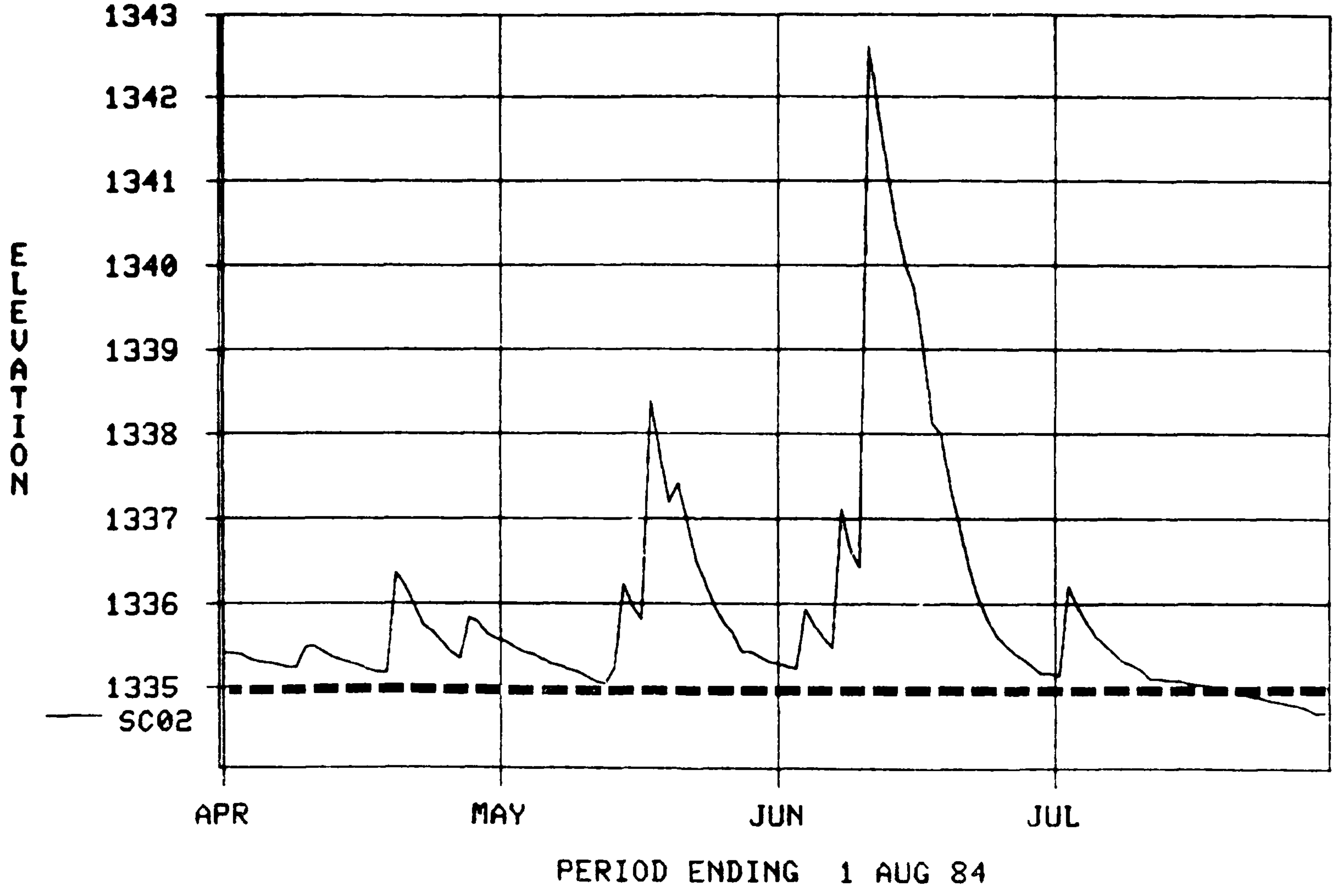
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA



MISSOURI RIVER AND TRIBUTARIES
POST-FLOOD REPORT
SPRING FLOODS 1984
EAST CENTRAL NEBRASKA
STORM OF 15-16 JUNE 1984
ISOHYETAL STORM PATTERN
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

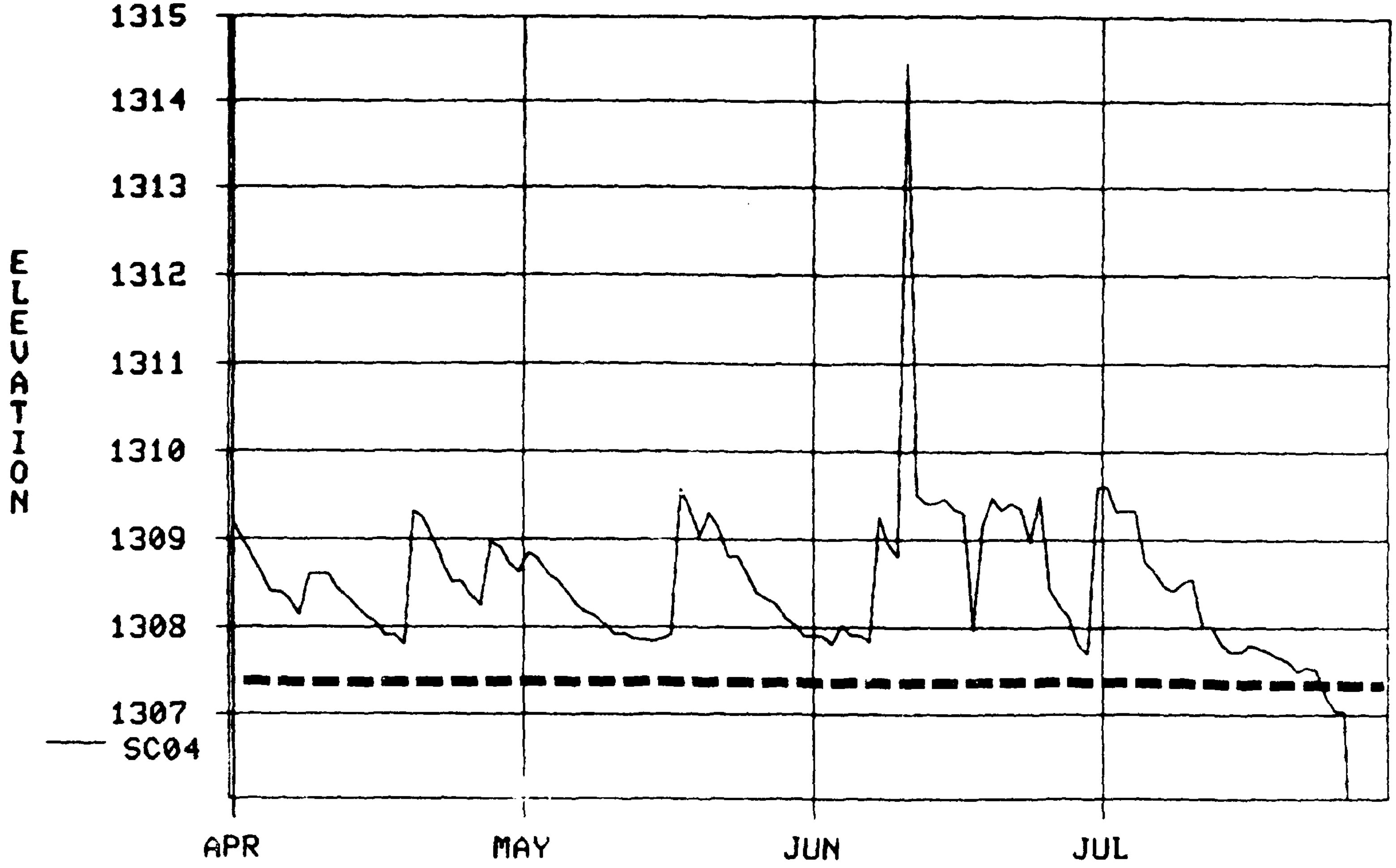
PLATE 4

SALT CREEK #2 - OLIVE CREEK LAKE
DAILY POOL ELEVATION



PLAT

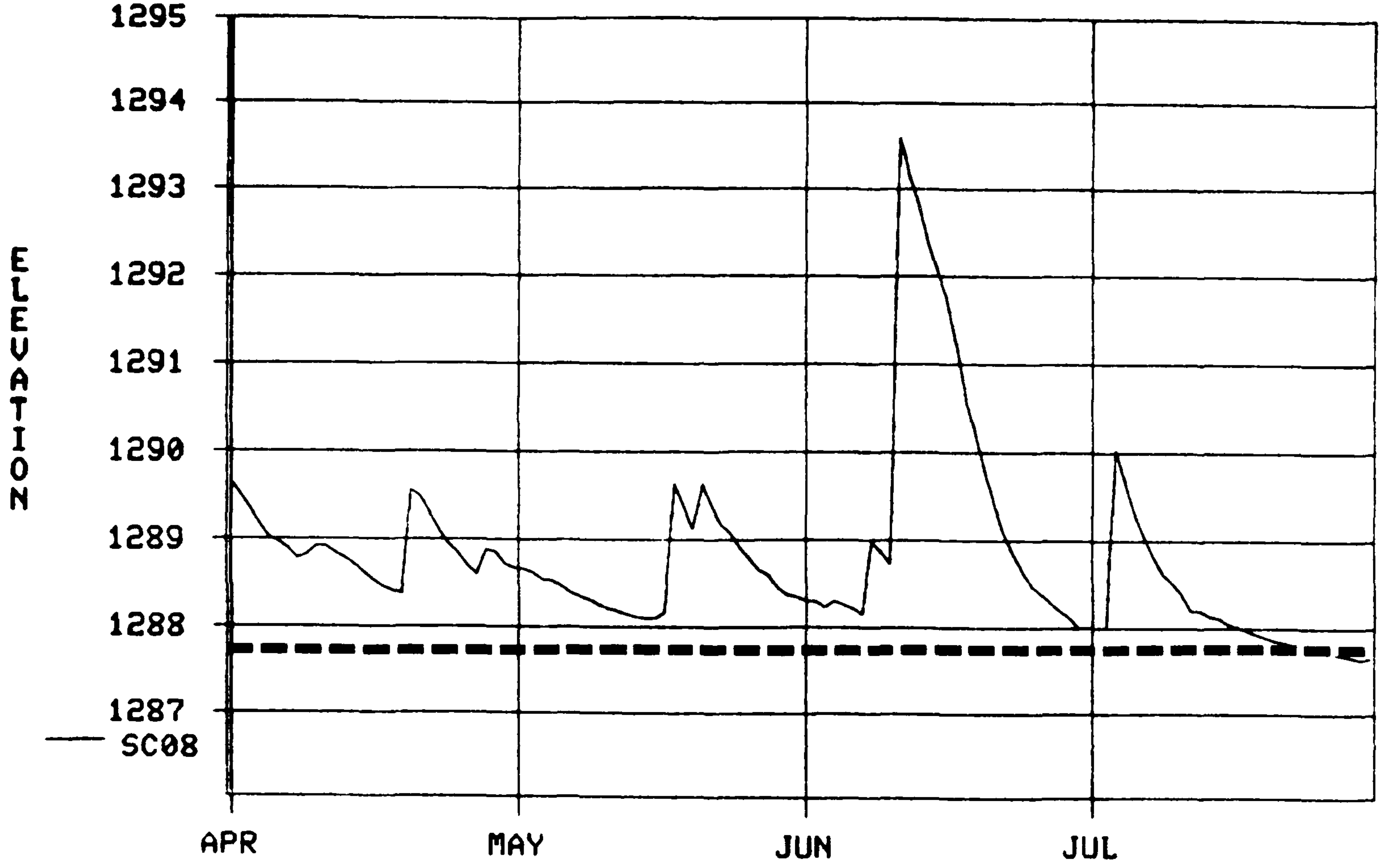
SALT CREEK $4 - BLUE STEM LAKE
DAILY POOL ELEVATION



PERIOD ENDING 1 AUG 84

PLATE

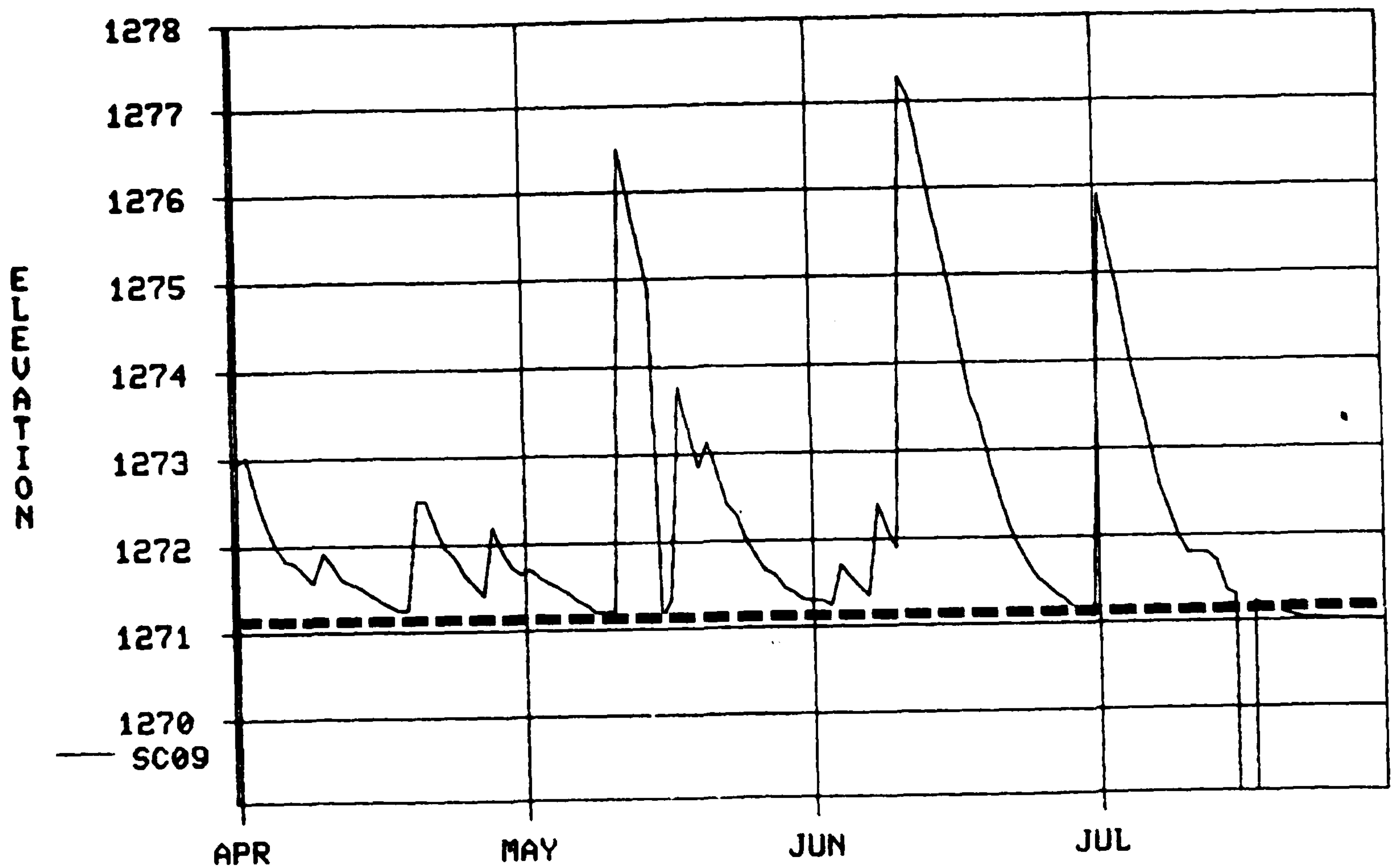
SALT CREEK #8 - WAGON TRAIN LAKE
DAILY POOL ELEVATION



PERIOD ENDING 1 AUG 84

STORAGE ZONE = 1287.8 - 1302.0 ft. M.S.L.

SALT CREEK #9 - STAGECOACH LAKE
DAILY POOL ELEVATION

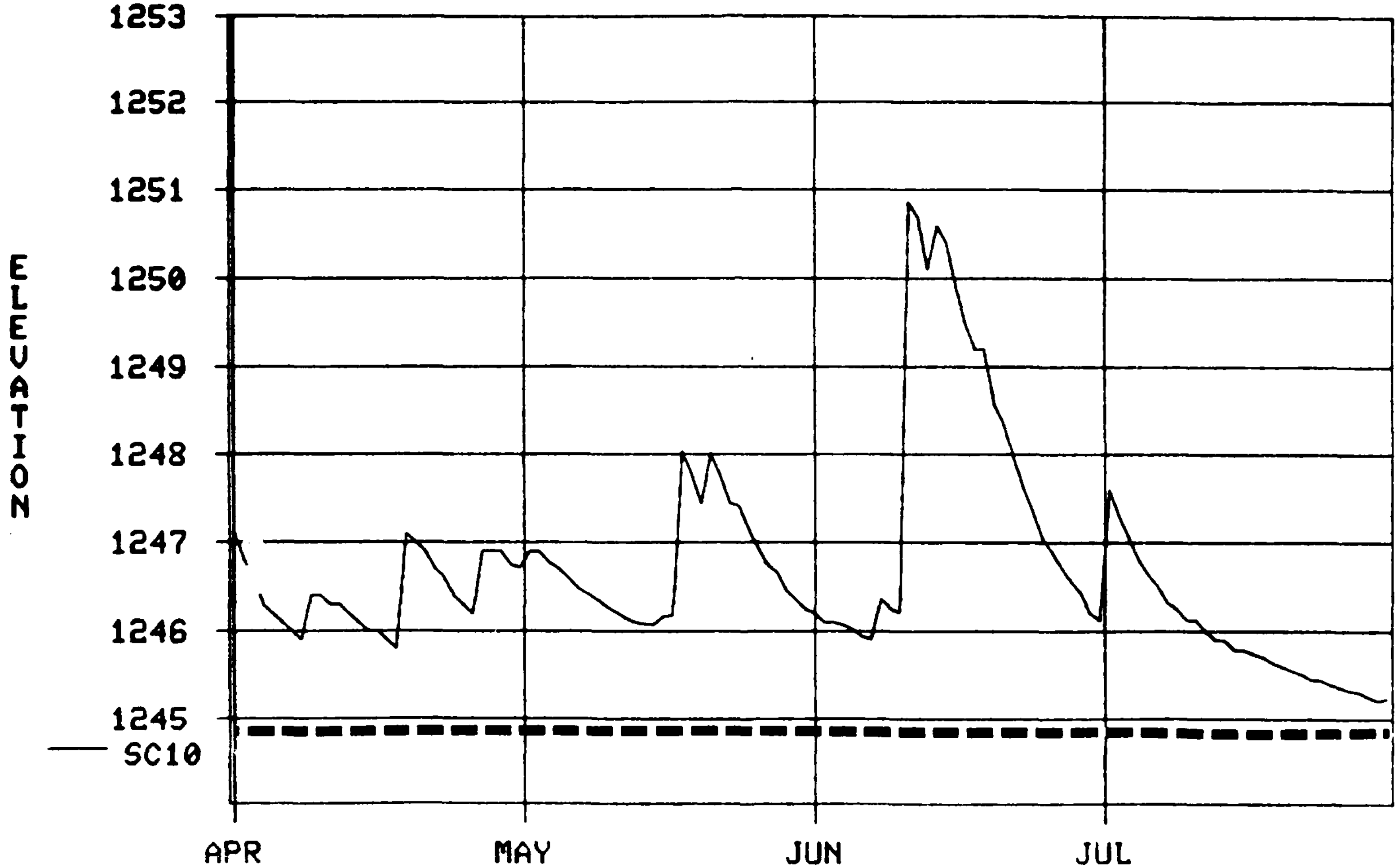


PERIOD ENDING 1 AUG 84

EXCLUSIVE FLOOD STORAGE ZONE = 1271.1 - 1285.0 ft. M.S.L.

PLATE

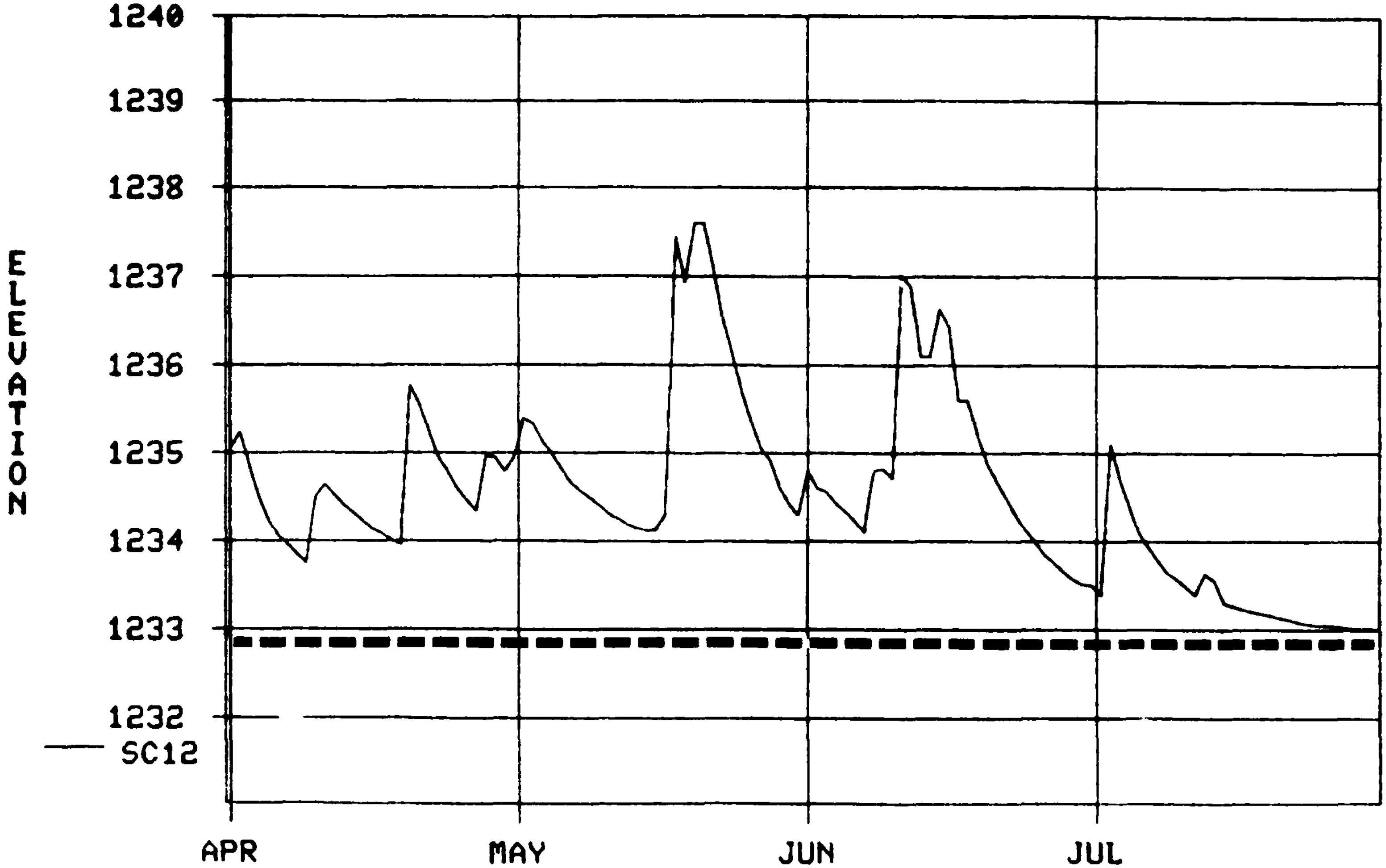
SALT CREEK #10 - YANKEE HILL LAKE
DAILY POOL ELEVATION



PERIOD ENDING 1 AUG 84

EXCLUSIVE FLOOD STORAGE ZONE = 1244.9 - 1262.0 ft. M.S.L.

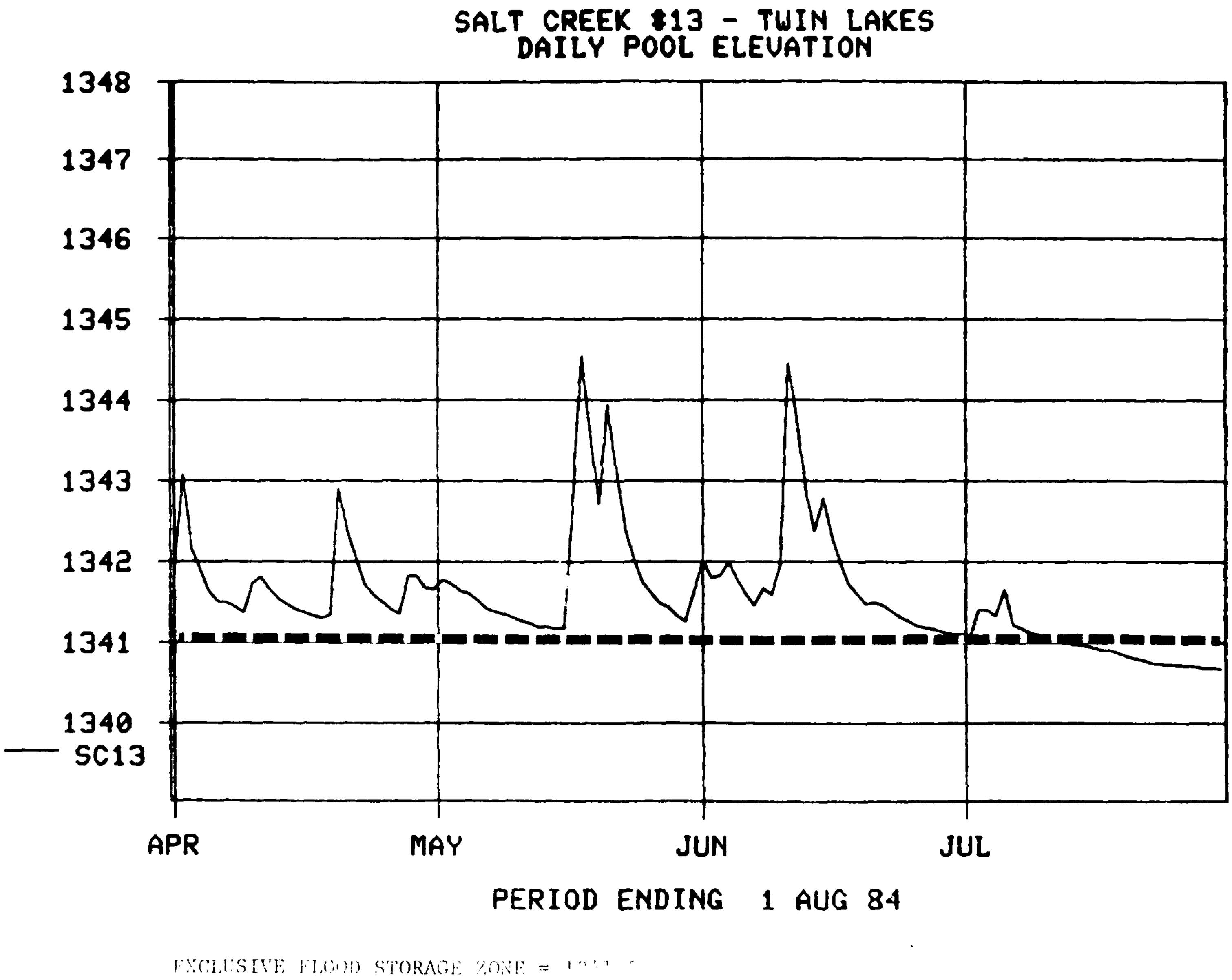
SALT CREEK #12 - CONESTOGA LAKE
DAILY POOL ELEVATION



PERIOD ENDING 1 AUG 84

EXCLUSIVE FLOOD STORAGE ZO...

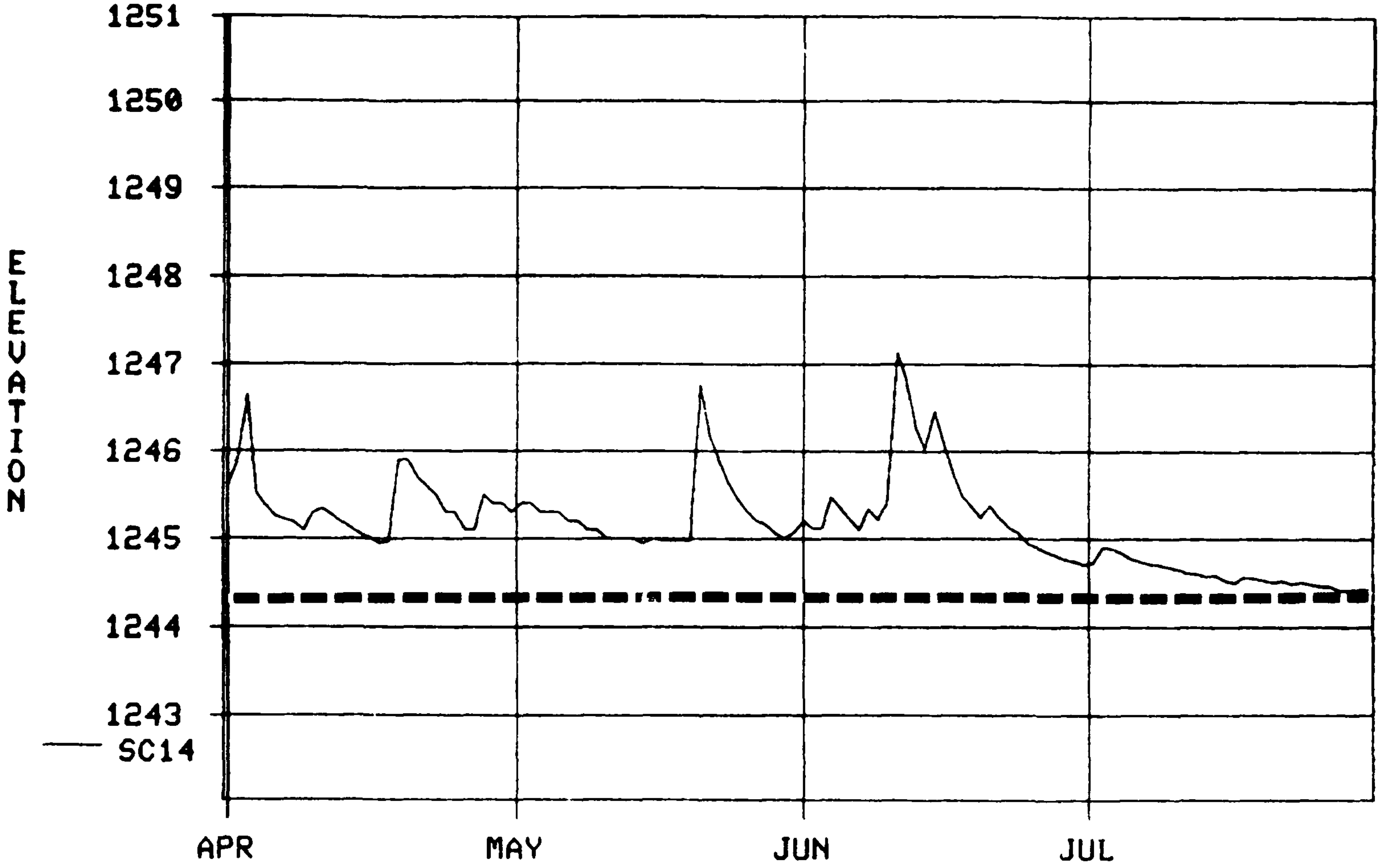
PLATE



SALT CREEK $13 - TWIN LAKES
DAILY POOL ELEVATION
ELEVATION
1348
1347
1346
1345
1344
1343
1342
1341
1340
SC13
APR
MAY
JUN
JUL
PERIOD ENDING 1 AUG 84
EXCLUSIVE FLOOD STORAGE ZONE =

PLATE

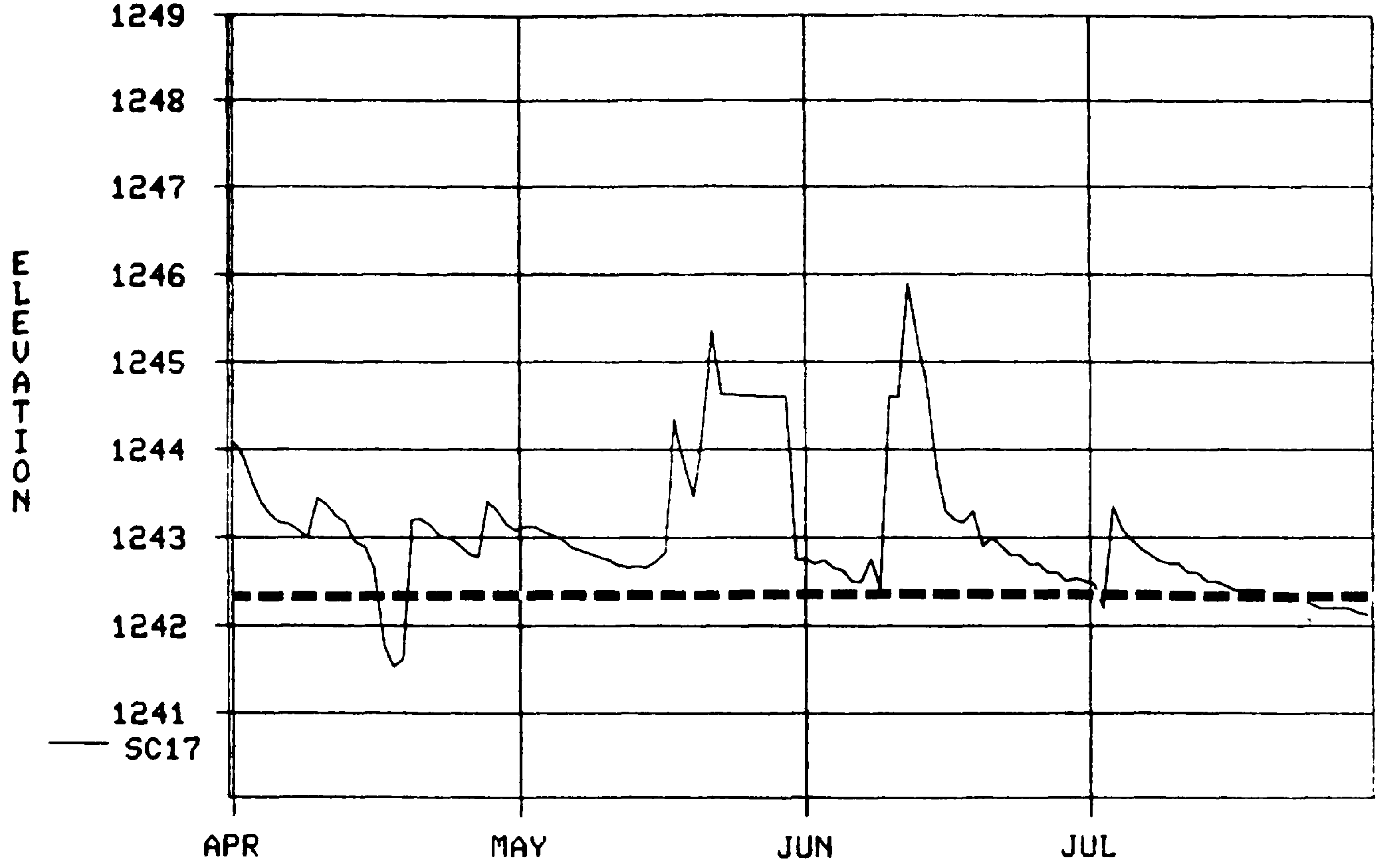
SALT CREEK #14 - PAWNEE LAKE
DAILY POOL ELEVATION



PERIOD ENDING 1 AUG 84

EXCLUSIVE FLOOD STORAGE ZONE = 1244.3 - 1263.5 ft. M.S.L.

SALT CREEK #17 - HOLMES PARK LAKE
DAILY POOL ELEVATION

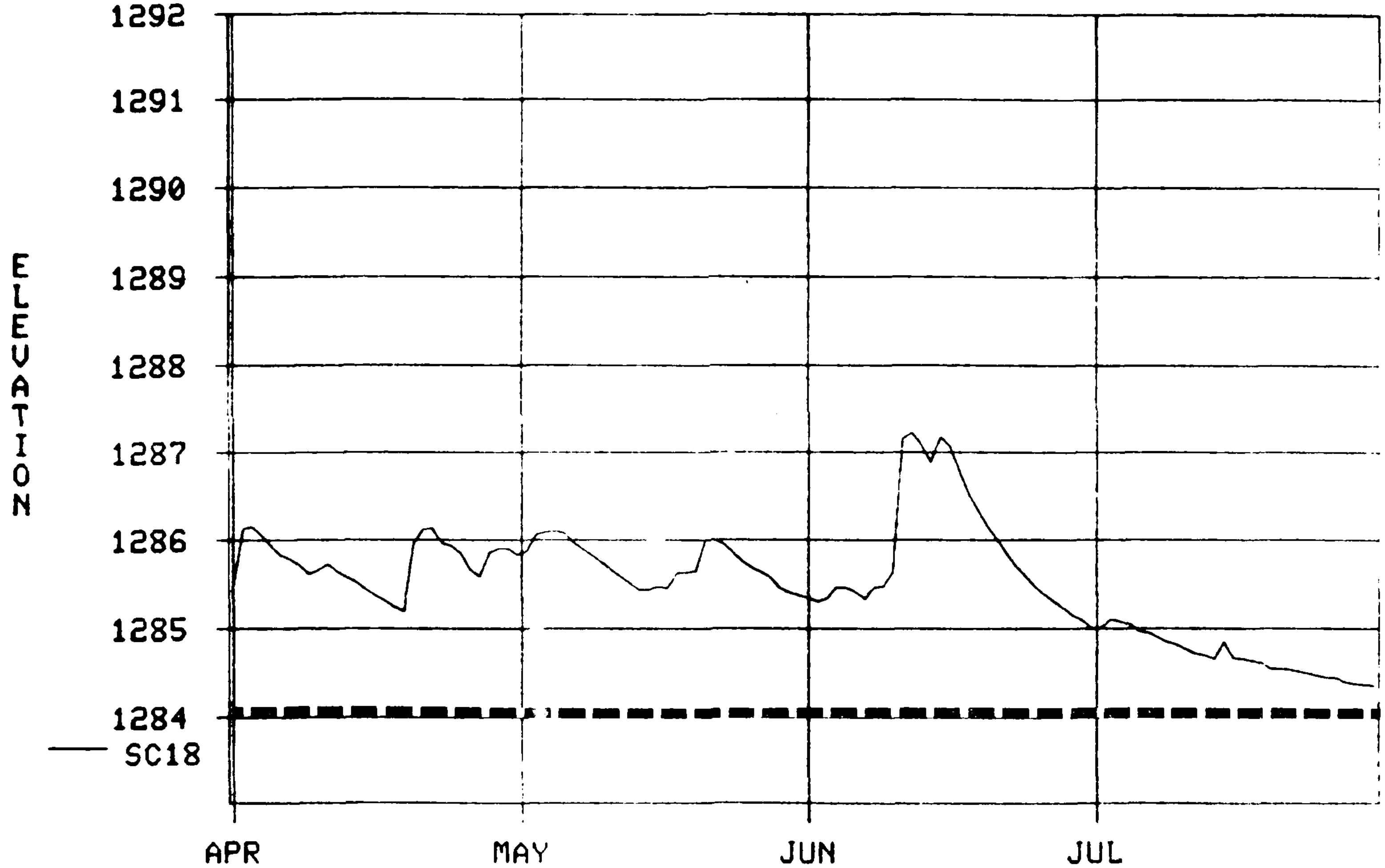


PERIOD ENDING 1 AUG 84

EXCLUSIVE FLOOD STORAGE ZONE = 1242.4 - 1266.0 ft. M.S.L.

PLATE

SALT CREEK #18 - BRANCHED OAK LAKE
DAILY POOL ELEVATION

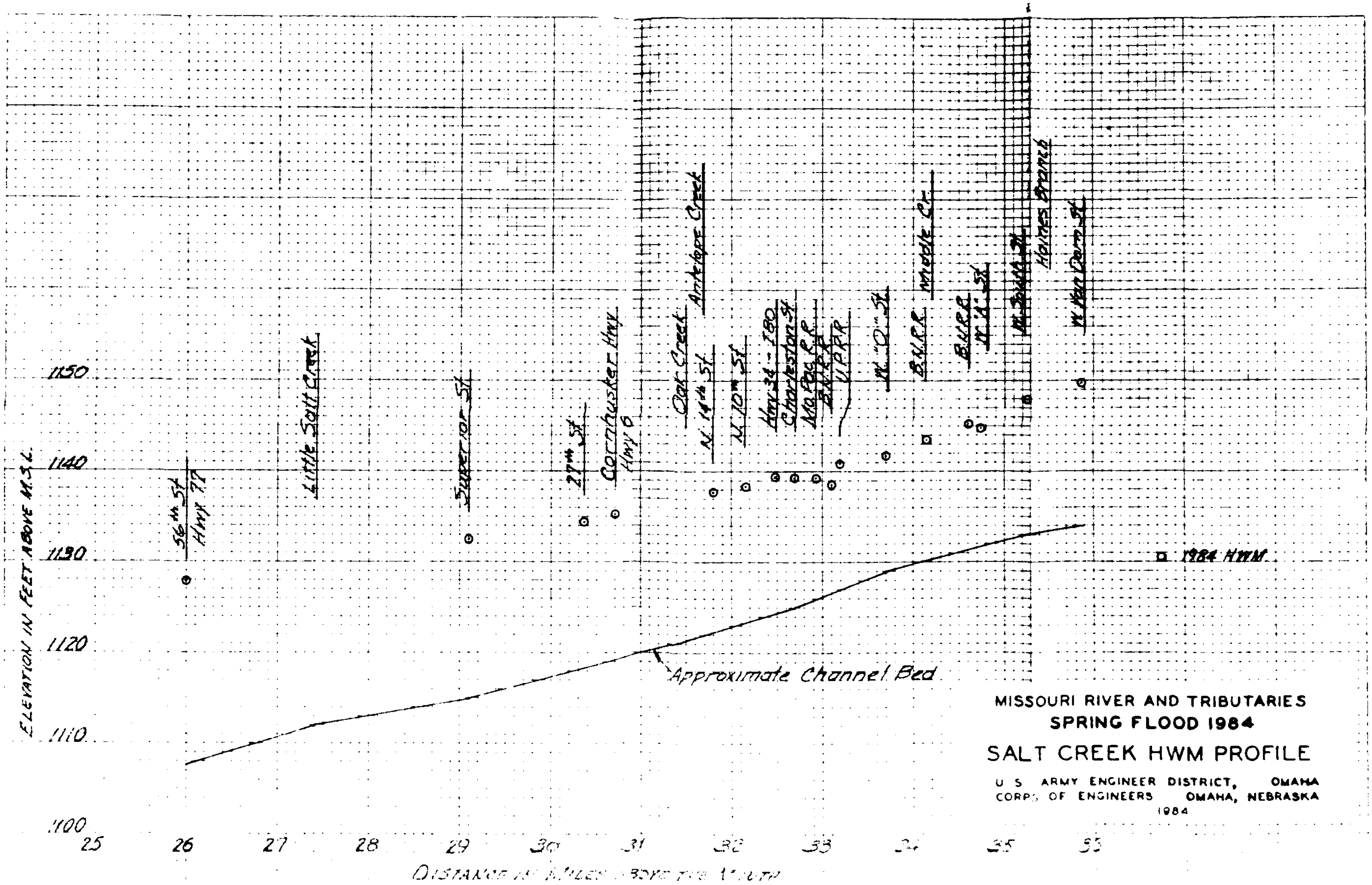


PERIOD ENDING 1 AUG 84

EXCLUSIVE FLOOD STORAGE ZONE = 1284.0 - 1311.0 ft. M.S.L.

PLATE 5

47 0703



MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

SALT CREEK HWM PROFILE

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
1984

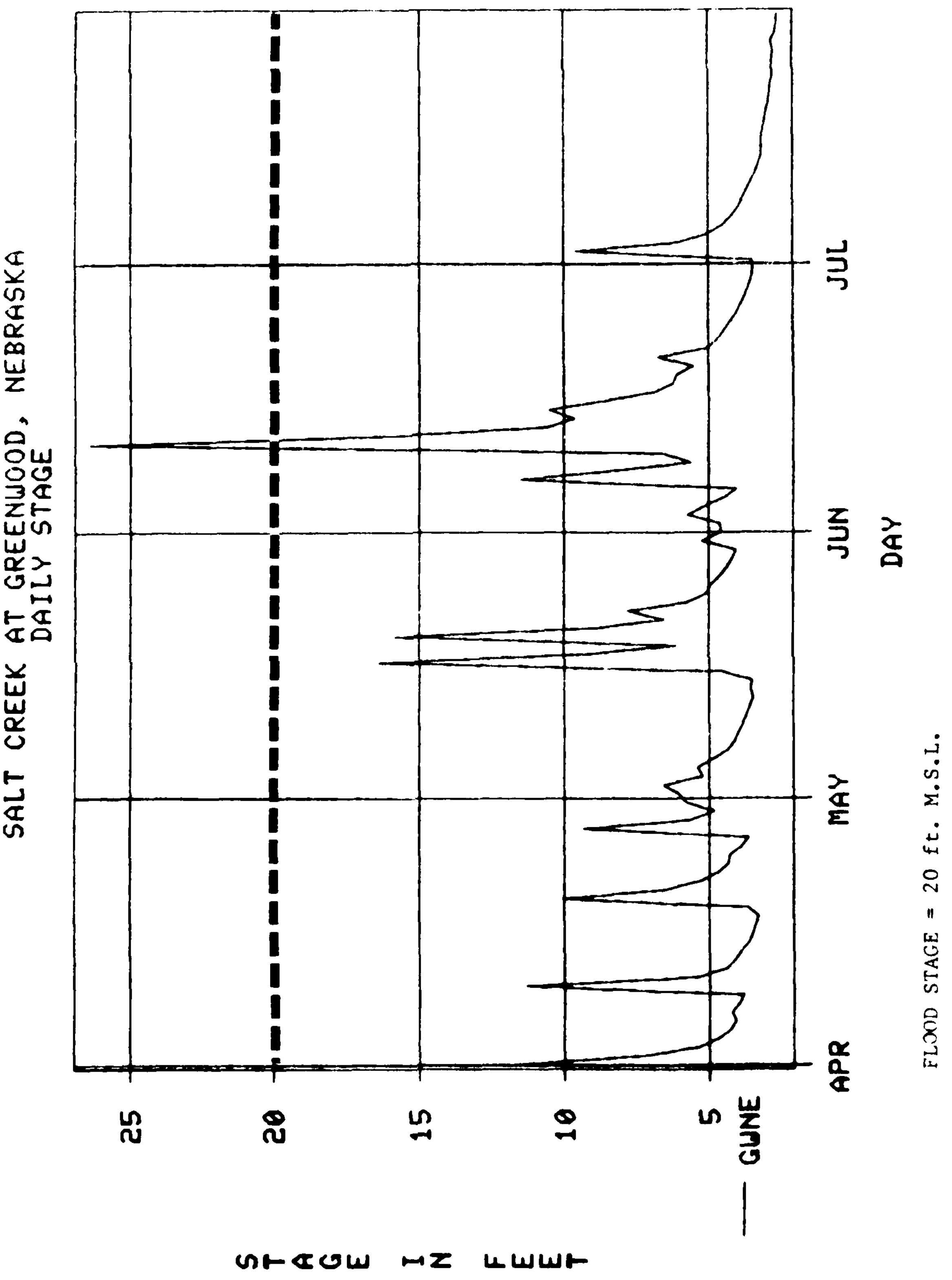
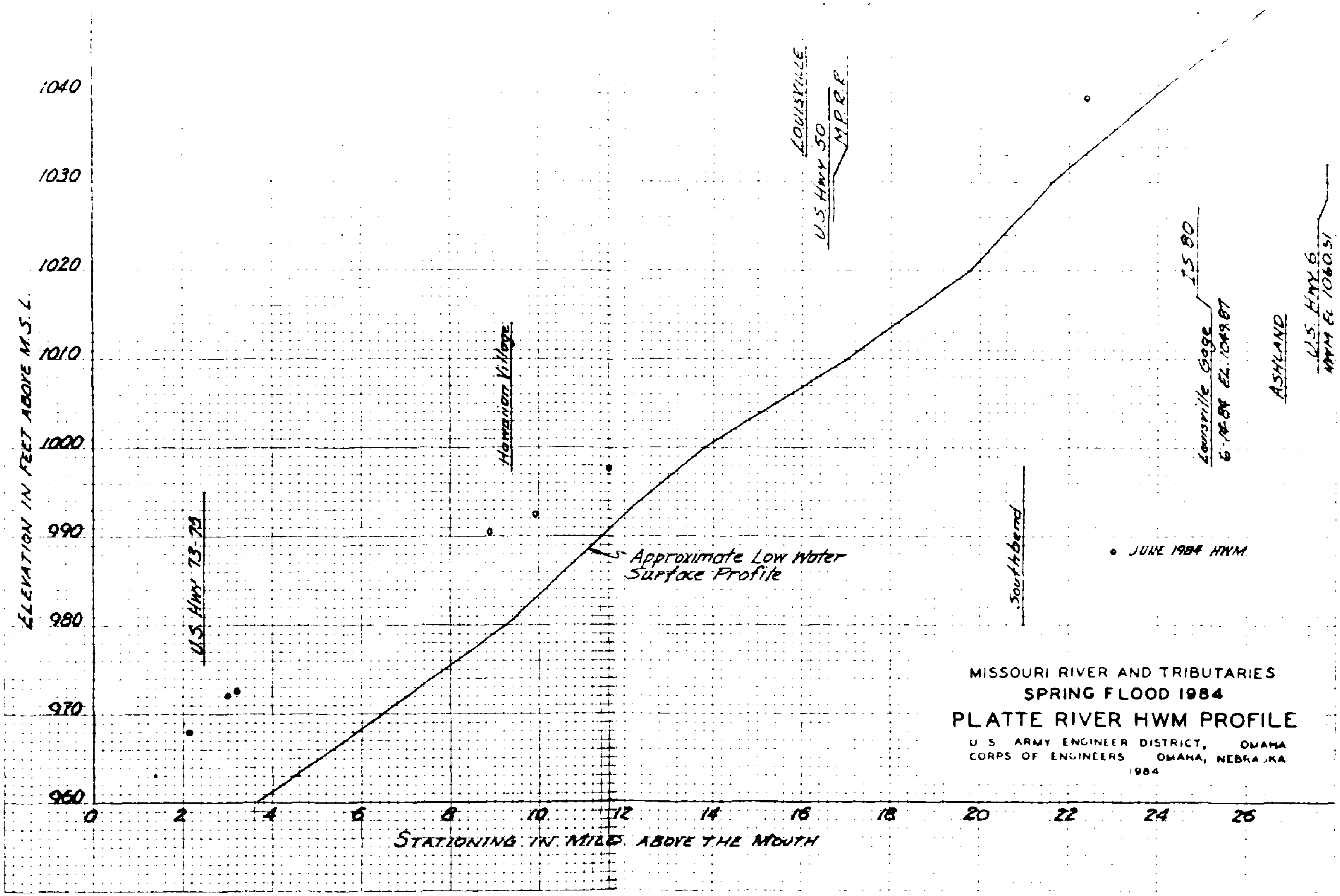
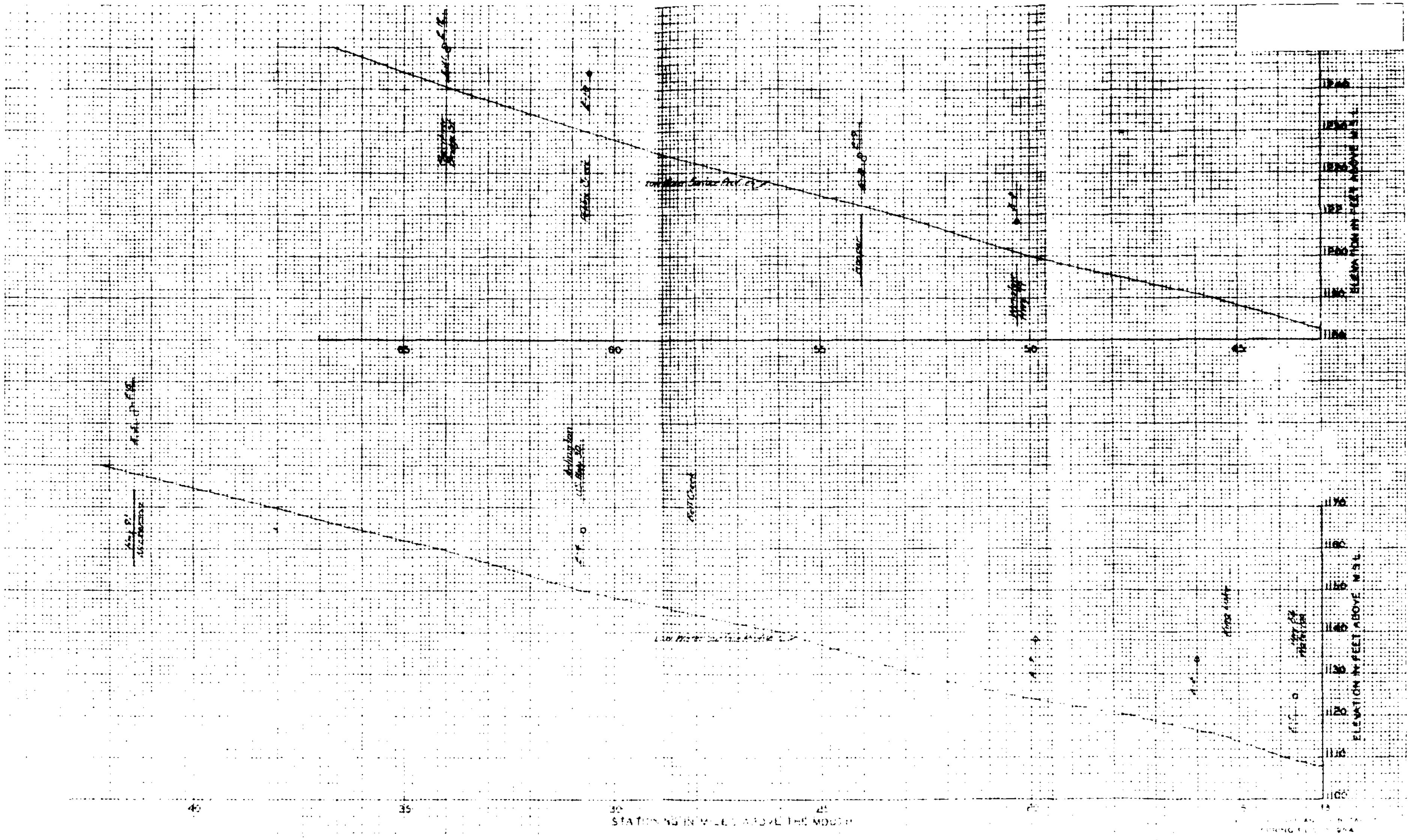

SALT CREEK AT GREENWOOD, NEBRASKA
DAILY STAGE
STAGE IN FEET
25
20
15
10
5
— GWNE
APR
MAY
JUN
JUL
DAY
FLOOD STAGE = 20 ft. M.S.L.

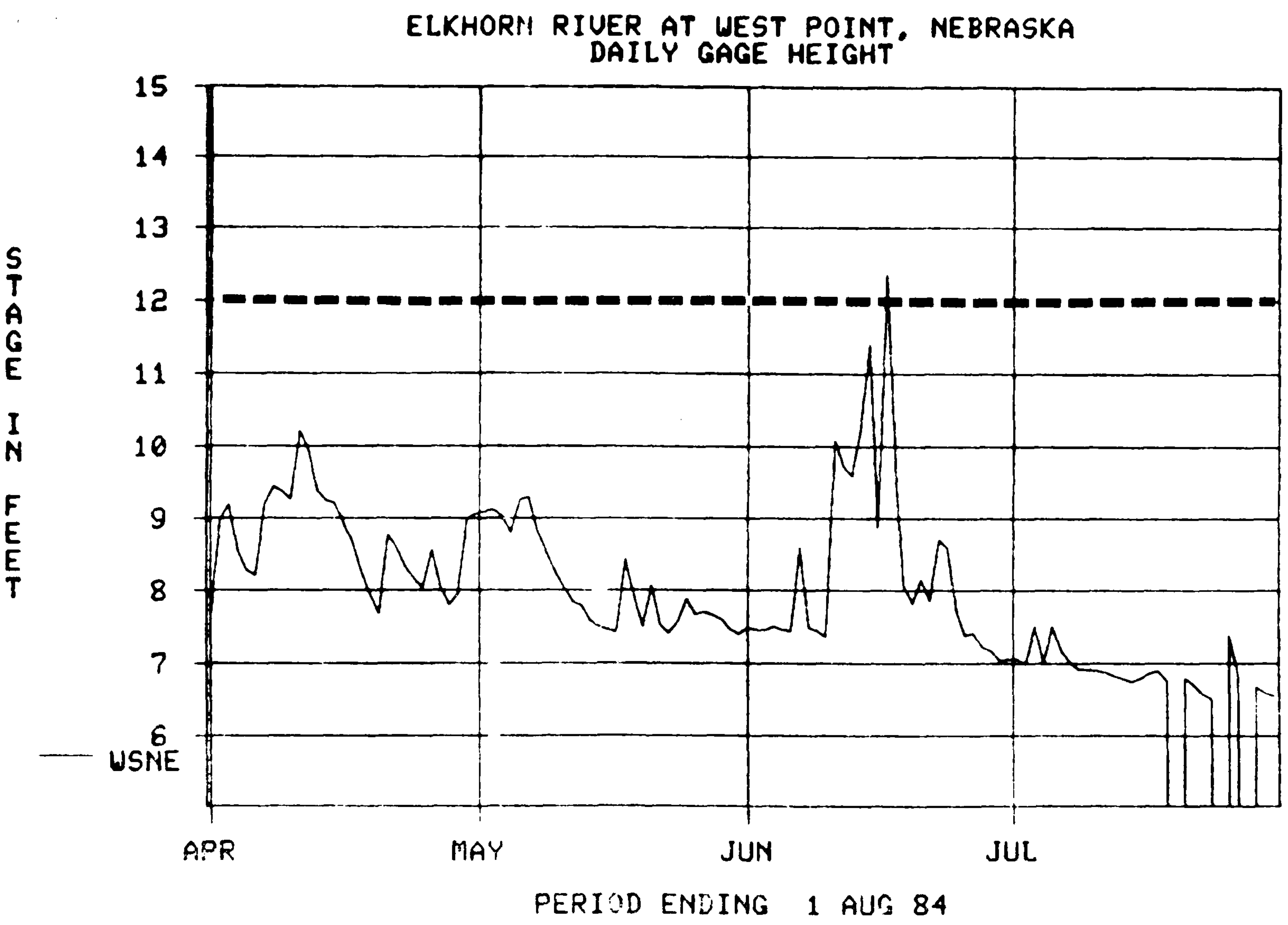
PLATE 56



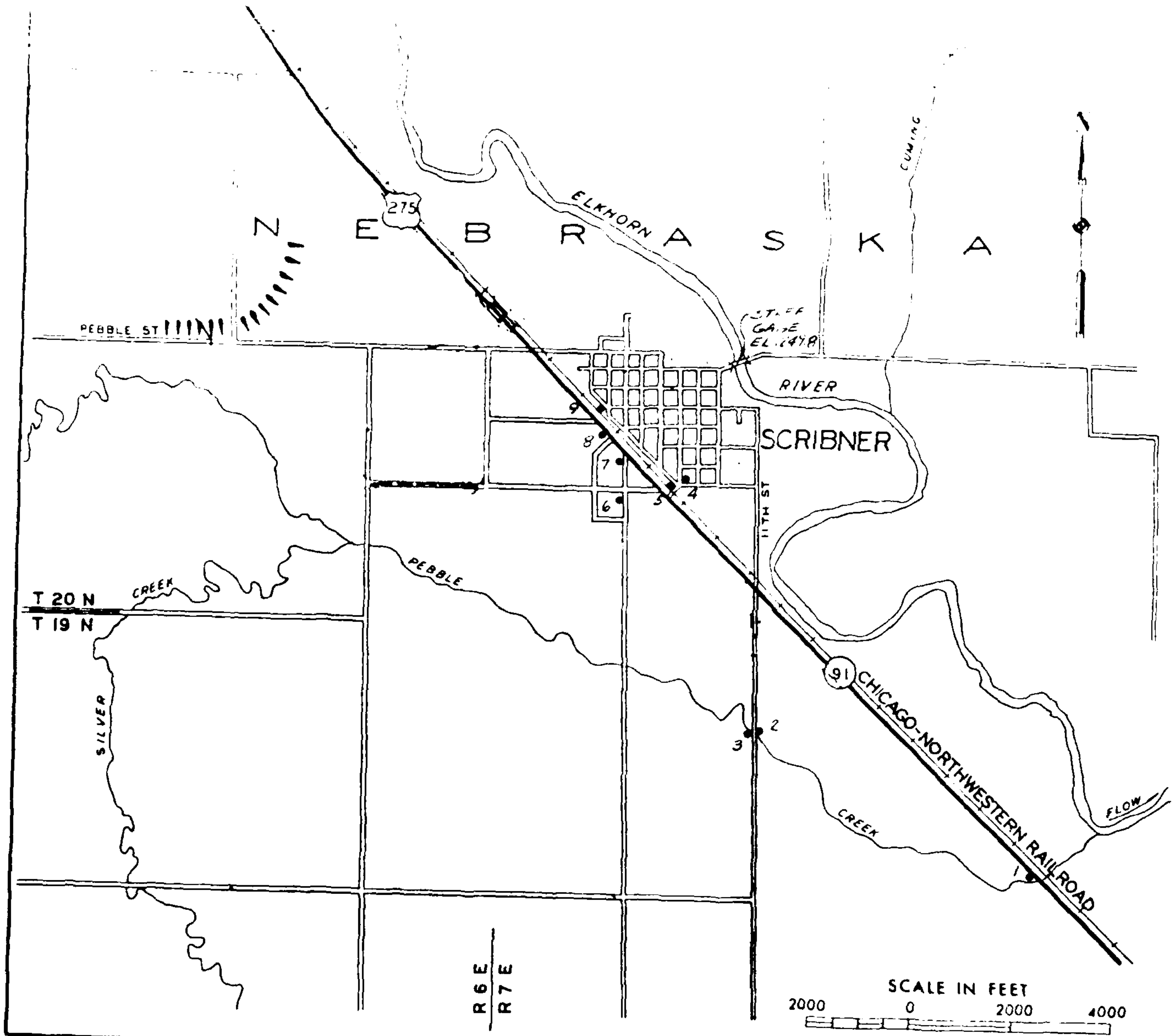
MISSOURI RIVER AND TRIBUTARIES
SPRING FLOOD 1984
PLATTE RIVER HWM PROFILE
U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
1984

PLATE 57


ELEVATION IN FEET ABOVE M.S.L.
STATIONING IN MILES ABOVE THE MOUTH
Bell Creek
Arlington



ELKHORN RIVER AT WEST POINT, NEBRASKA
DAILY GAGE HEIGHT
STAGE IN FEET
15
14
13
12
11
10
9
8
7
6
WSNE
APR
MAY
JUN
JUL
PERIOD ENDING 1 AUG 84



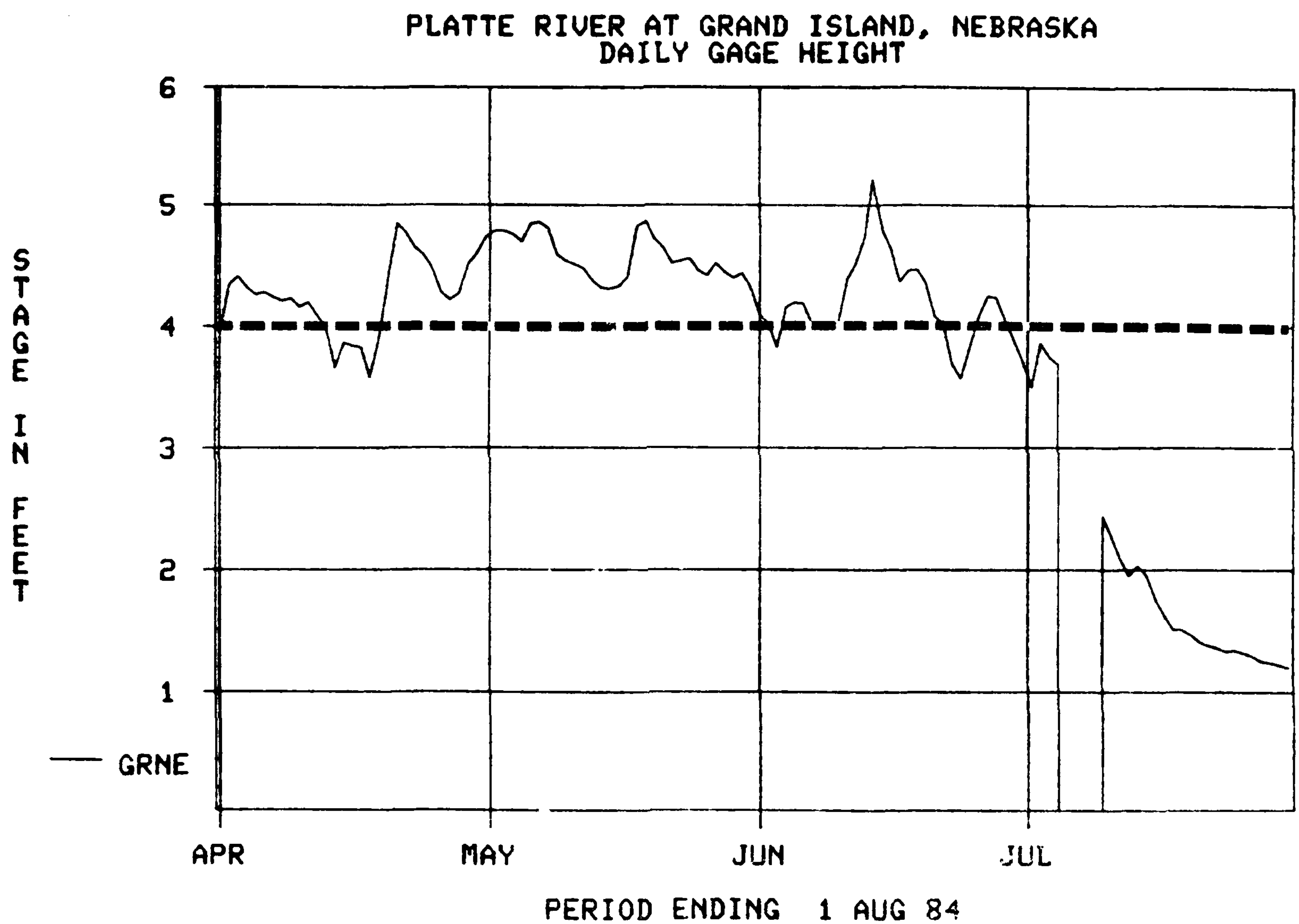
PEBBLE CREEK

HWM	ELEVATION
1	1243.88
2	1252.69
3	1252.72
4	1251.54
5	1252.47
6	1253.09
7	1253.00
8	1255.58
9	1254.80

MISSOURI RIVER AND TRIBUTARIES
SPRING FLOOD 1984

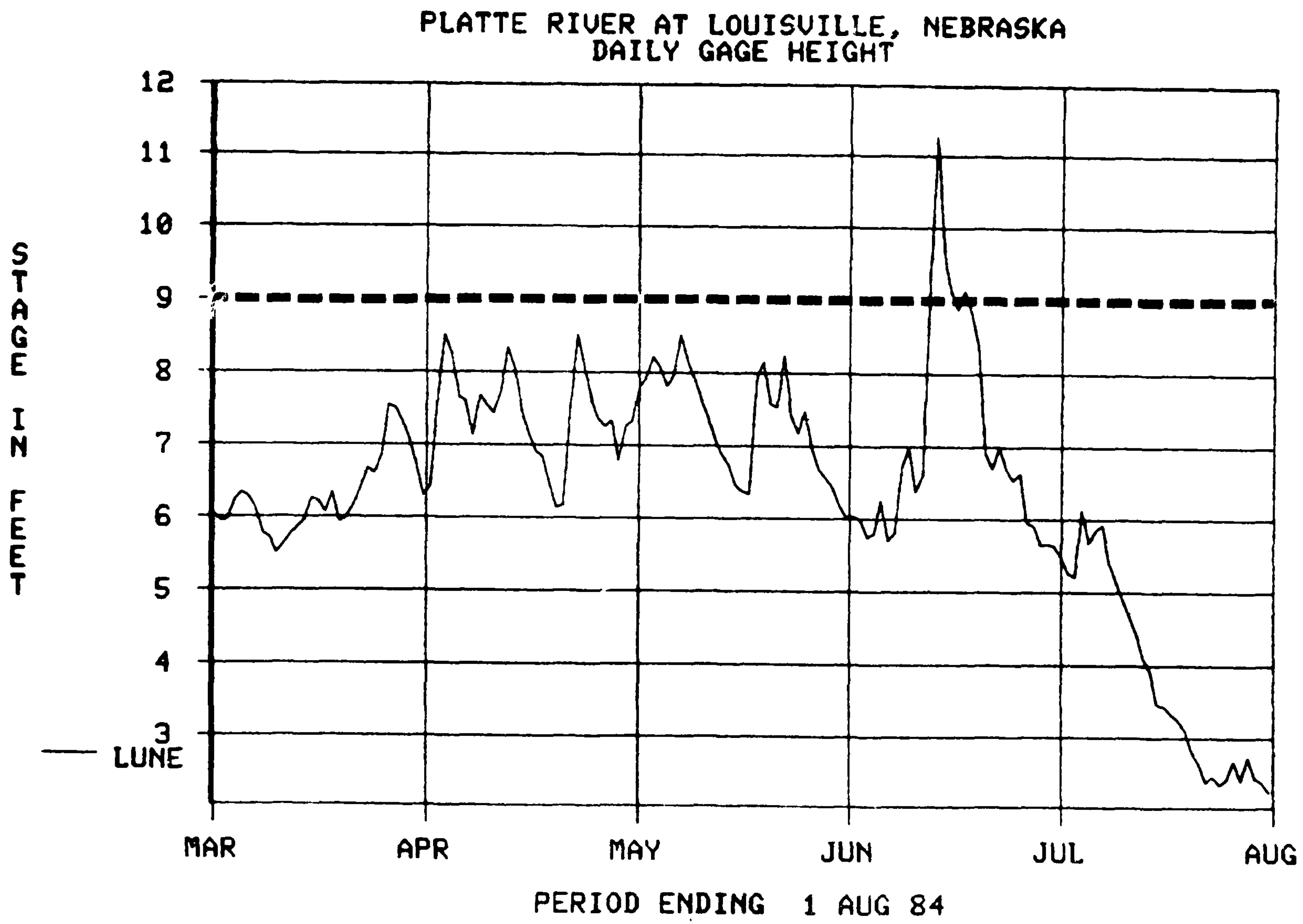
U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

PLATE 60



FLOOD STAGE = 4 ft. M.S.L.

PLATE



FLOOD STAGE = 9 ft. M.S.L.

PLATE 6

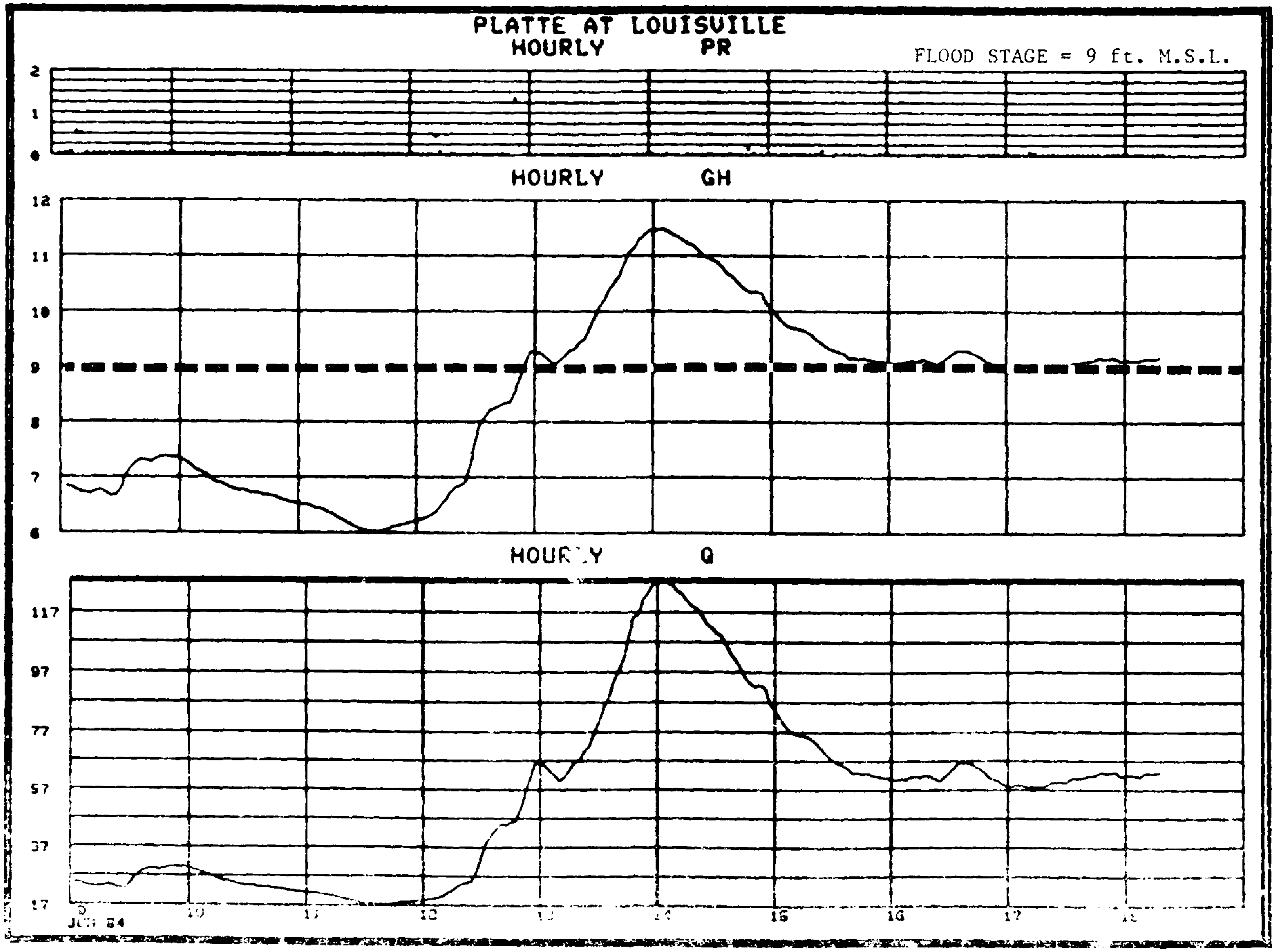
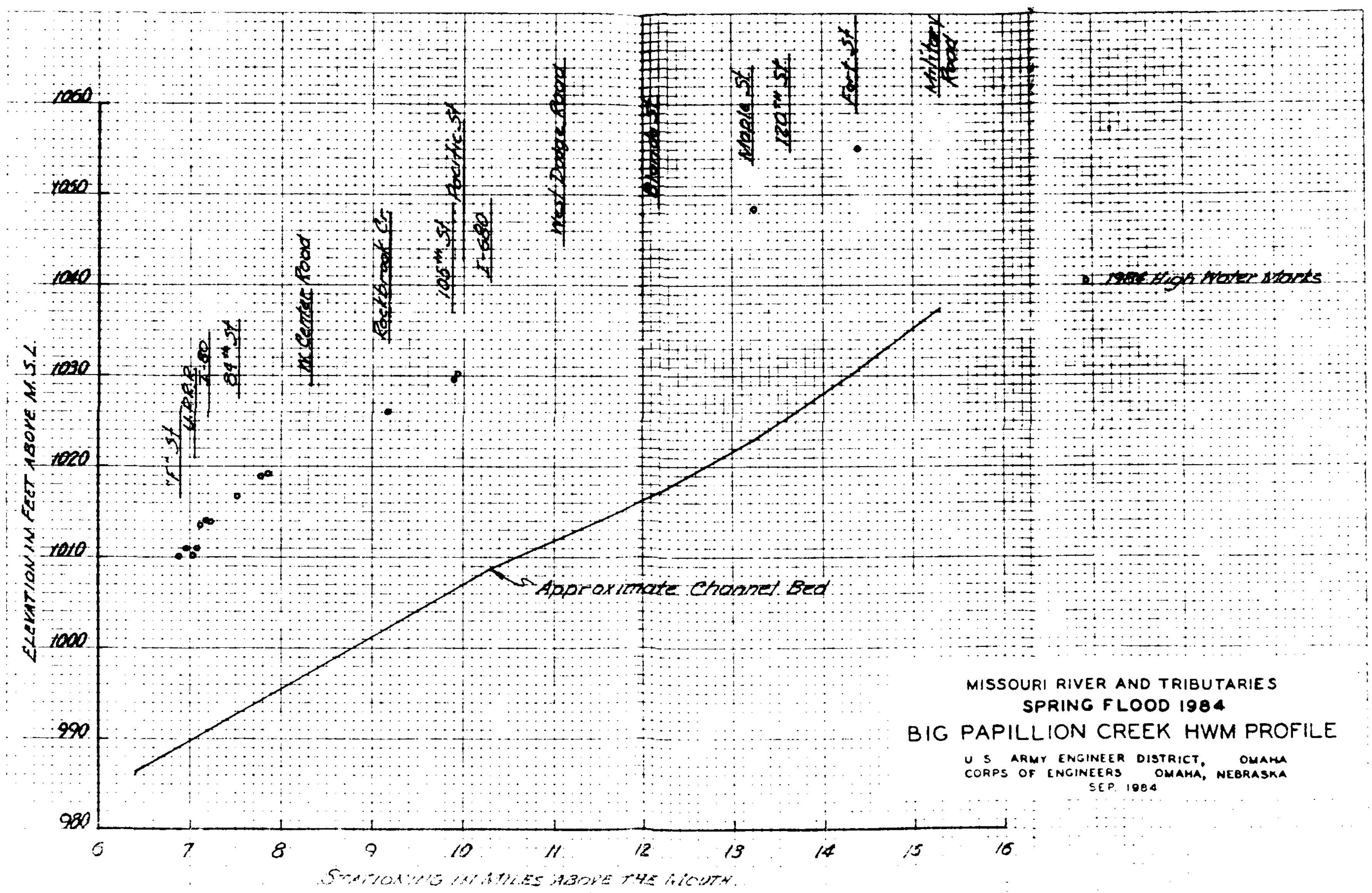
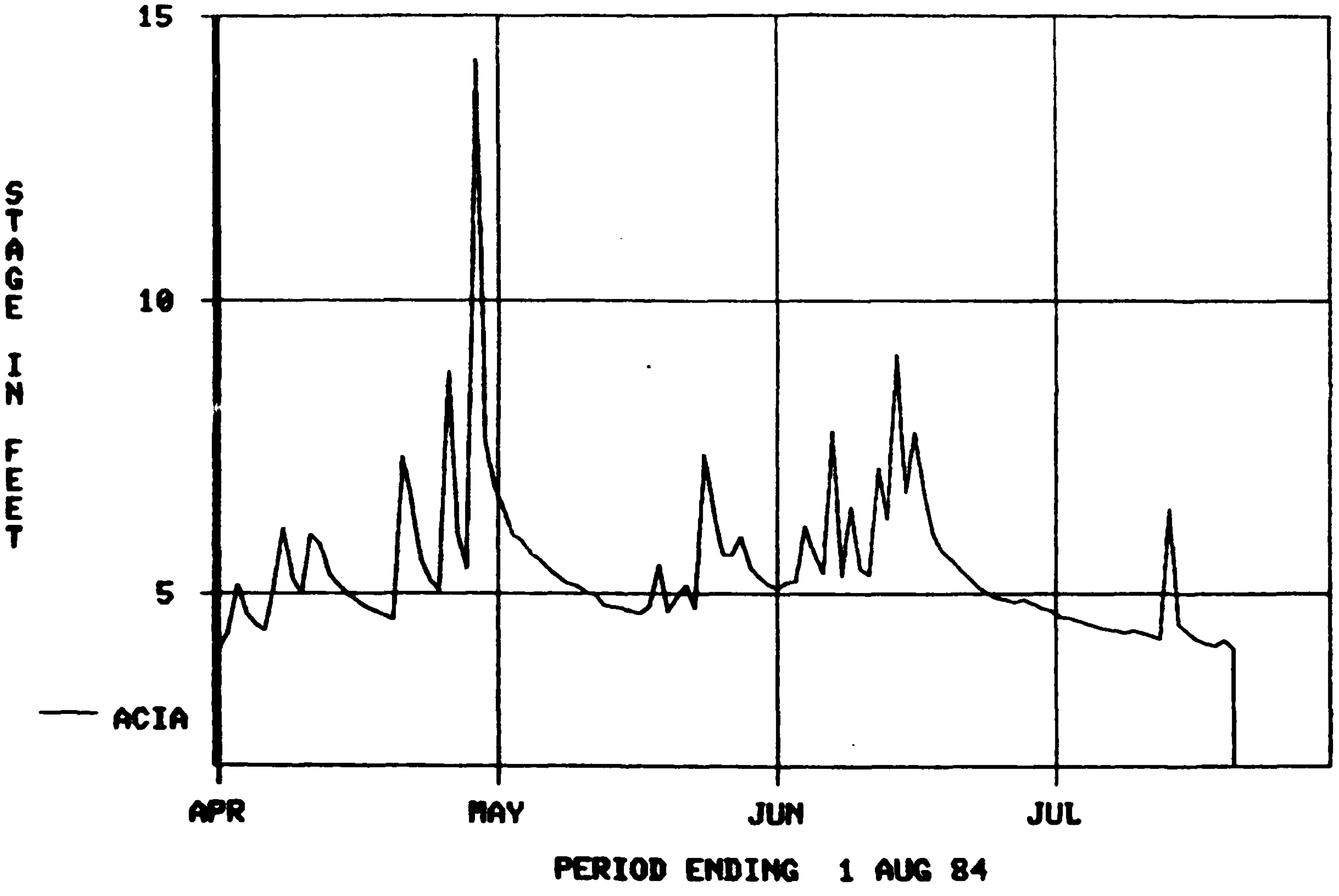

PLATTE AT LOUISVILLE
HOURLY PR
FLOOD STAGE = 9 ft. M.S.L.
2
1
0
HOURLY GH
12
11
10
9
8
7
6
Q
117
97
77
57
17
JUN 84
10
12
15
16
17

PLATE 6

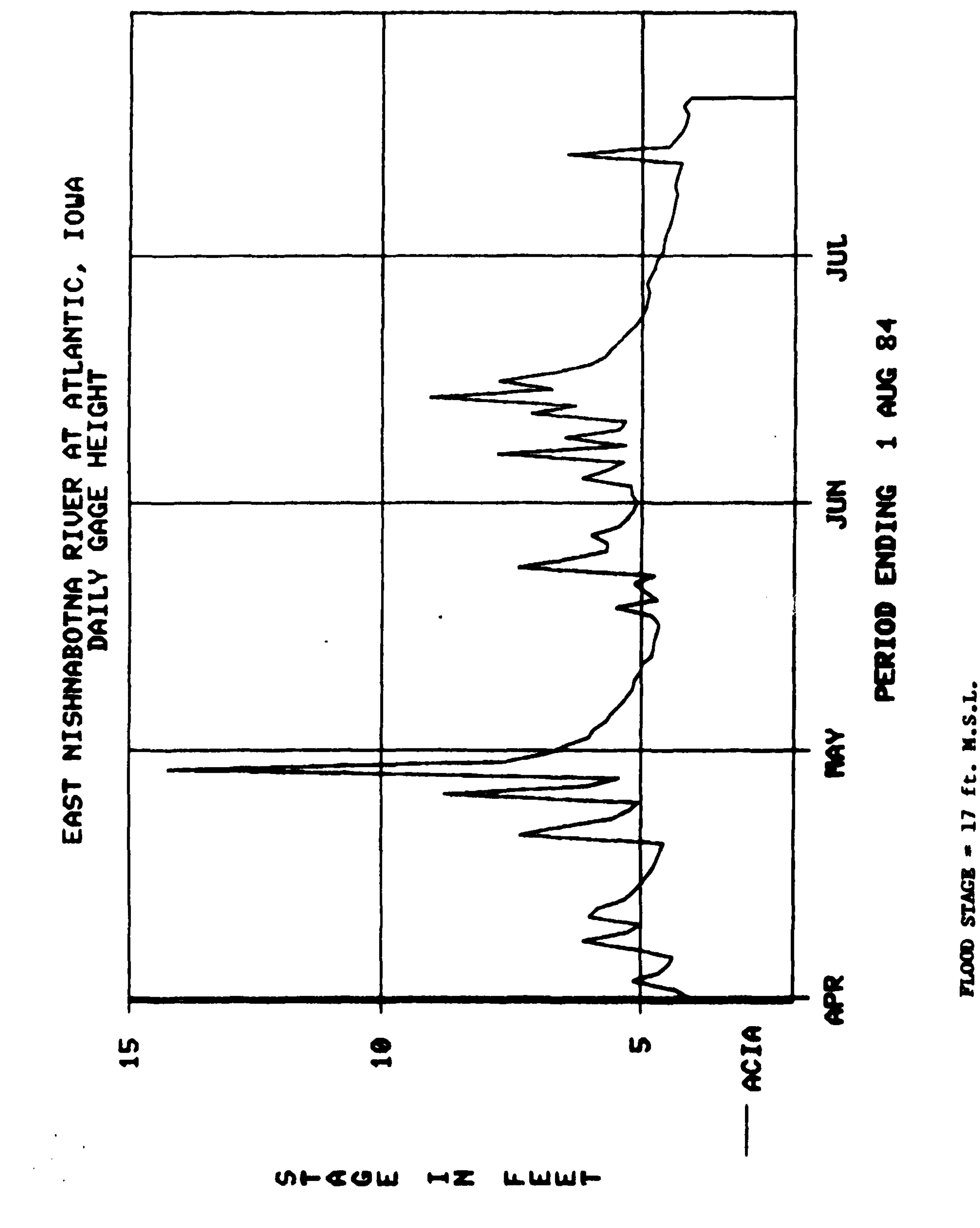


MISSOURI RIVER AND TRIBUTARIES
SPRING FLOOD 1984
BIG PAPILLION CREEK HWM PROFILE
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
SEP. 1984

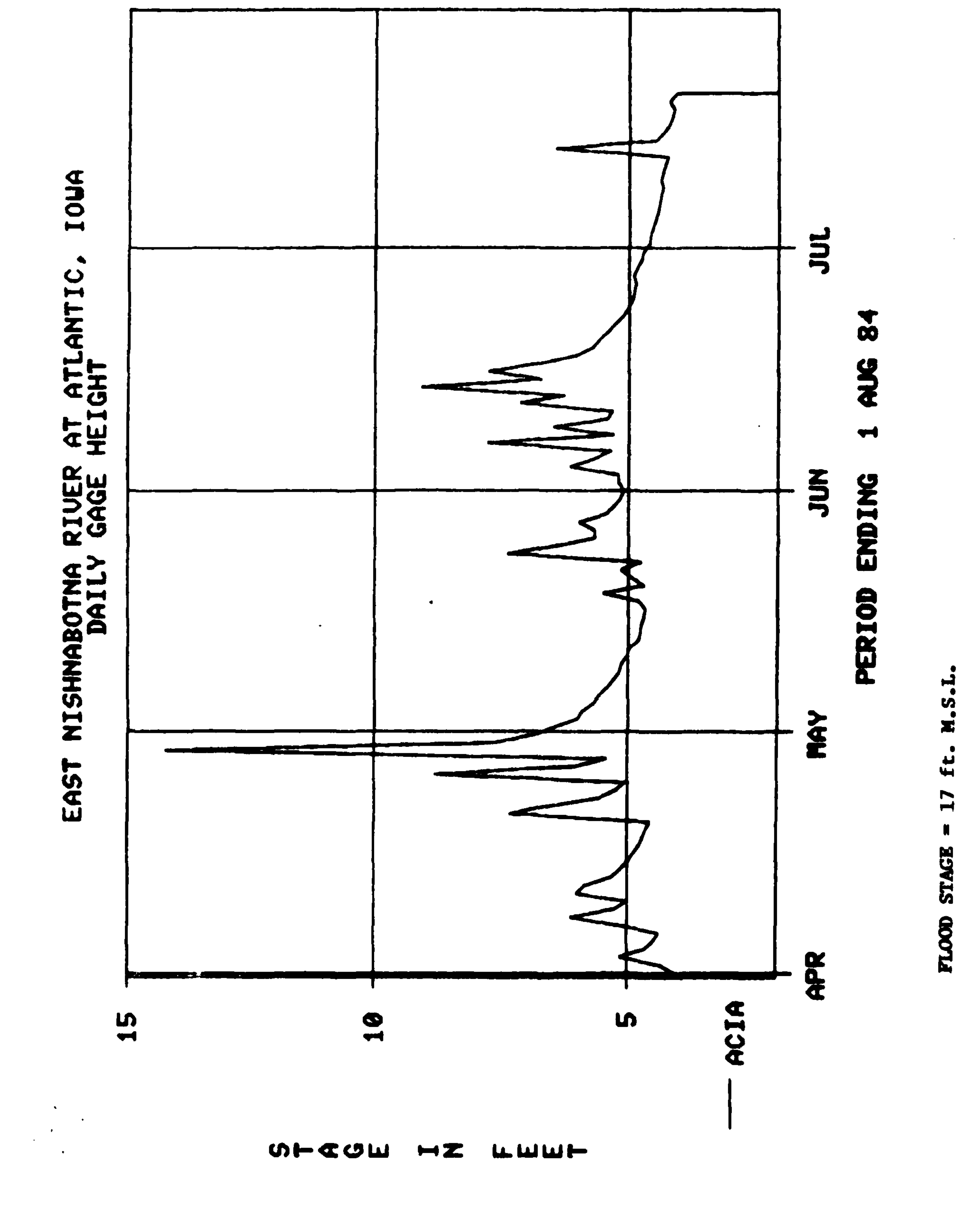
EAST NISHNABOTNA RIVER AT ATLANTIC, IOWA
DAILY GAGE HEIGHT



FLOOD STAGE = 17 ft. M.S.L.



EAST NISHNABOTNA RIVER AT ATLANTIC, IOWA
DAILY GAGE HEIGHT
STAGE IN FEET
15
10
5
— ACIA
APR
MAY
JUN
JUL
PERIOD ENDING 1 AUG 84
FLOOD STAGE = 17 ft. M.S.L.


EAST NISHNABOTNA RIVER AT ATLANTIC, IOWA
DAILY GAGE HEIGHT
STAGE IN FEET
15
10
5
APR
MAY
JUN
JUL
PERIOD ENDING 1 AUG 84
— ACIA
FLOOD STAGE = 17 ft. M.S.L.

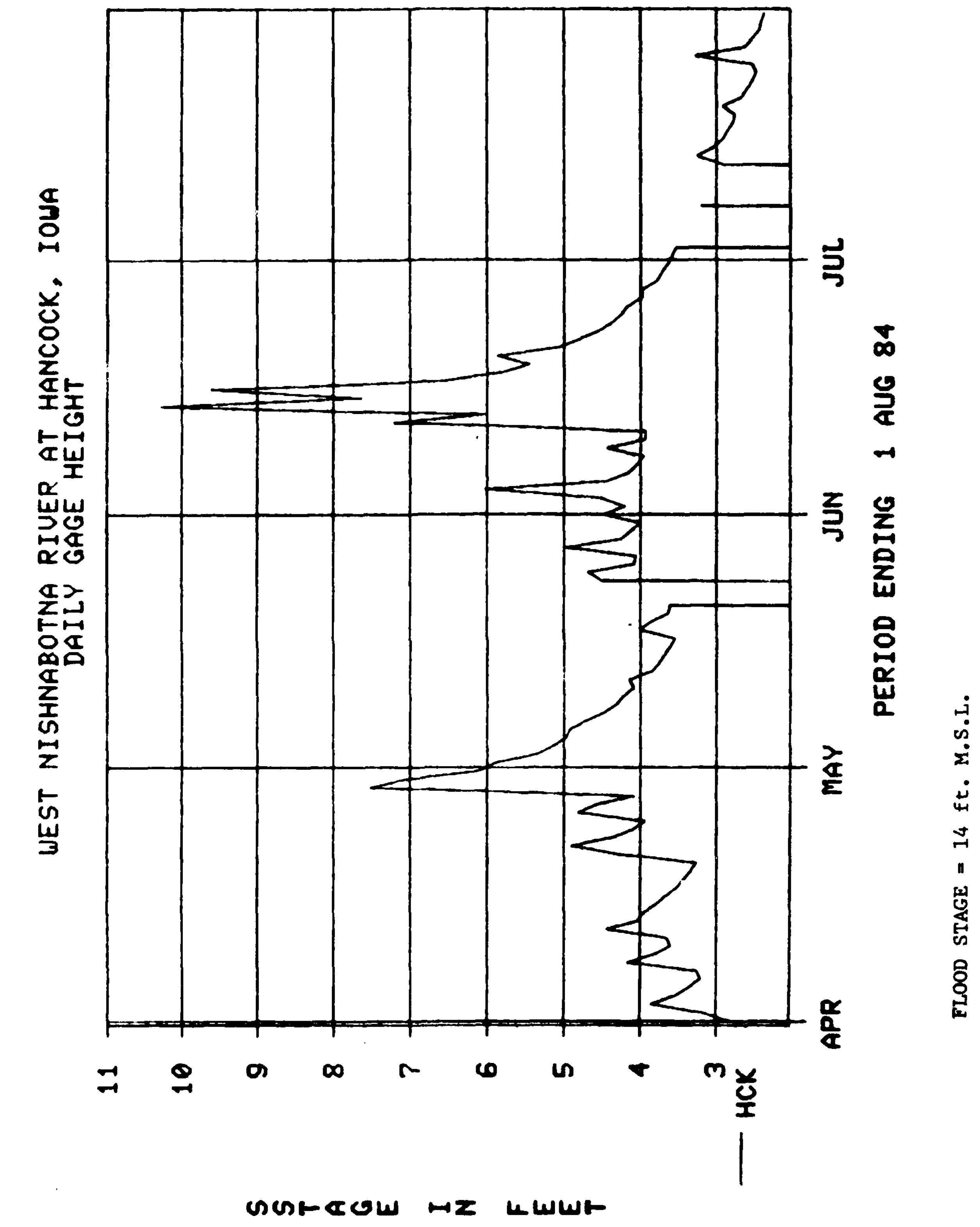

WEST NISHNABOTNA RIVER AT HANCOCK, IOWA
DAILY GAGE HEIGHT
STAGE IN FEET
— HCK
11
10
9
8
7
6
5
4
3
APR
MAY
JUN
JUL
PERIOD ENDING 1 AUG 84
FLOOD STAGE = 14 ft. M.S.L.

PLATE 66

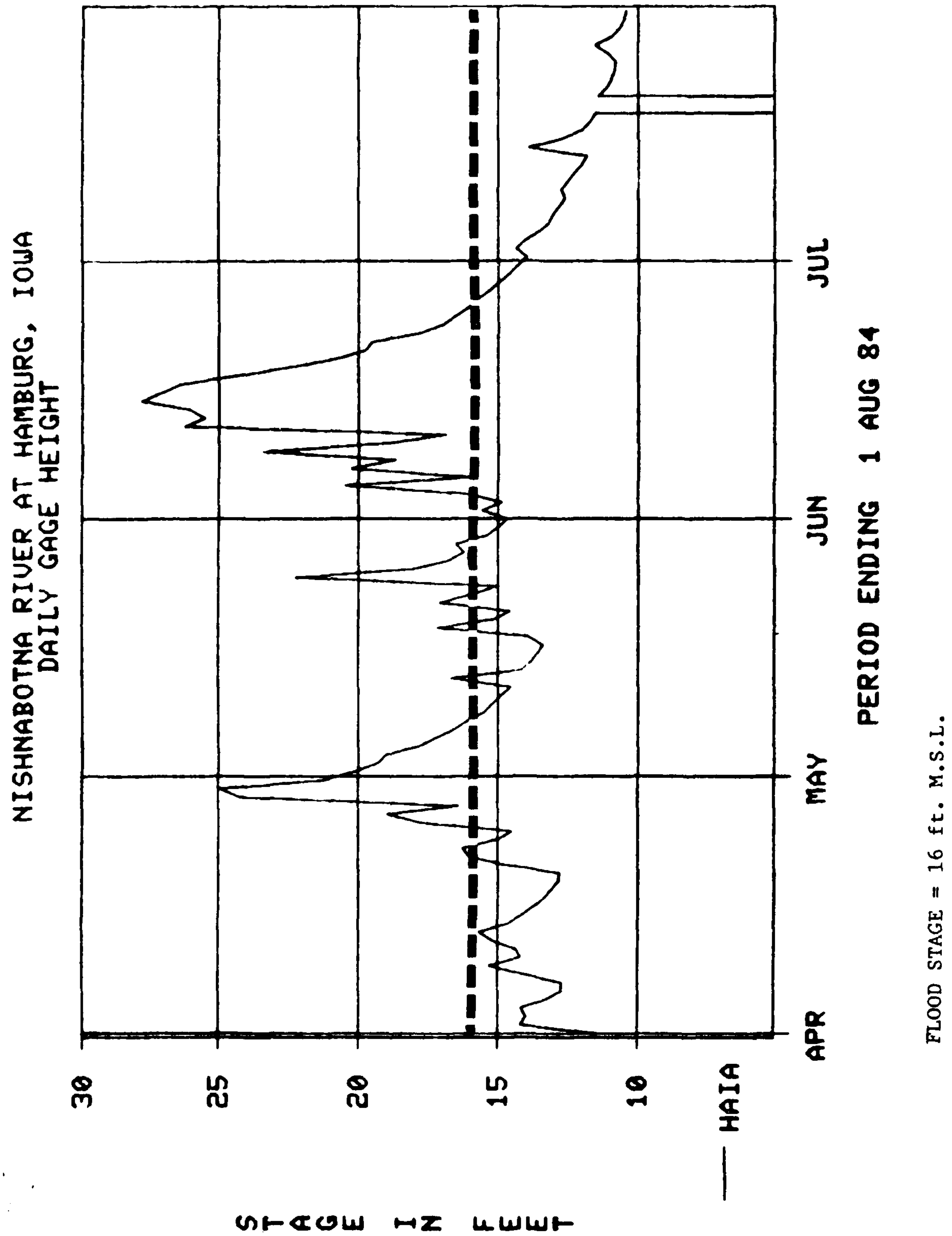
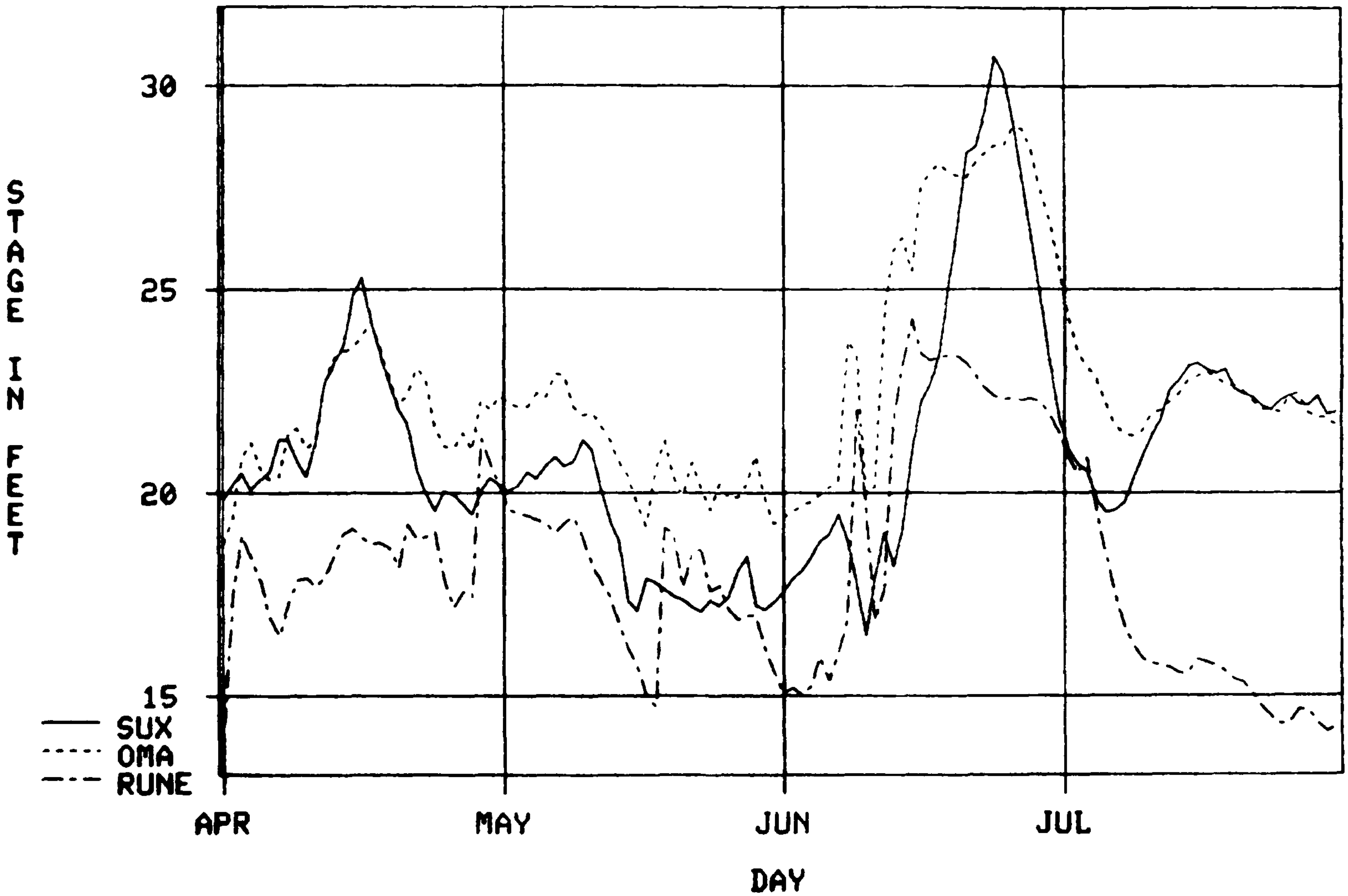

NISHNABOTNA RIVER AT HAMBURG, IOWA
DAILY GAGE HEIGHT
STAGE IN FEET
30
25
20
15
10
APR
MAY
JUN
JUL
PERIOD ENDING 1 AUG 84
FLOOD STAGE = 16 ft. M.S.L.

PLATE 67

MISSOURI RIVER
DAILY STAGES



FLOOD STAGES: SIOUX CITY = 36 ft.; OMAHA = 29 ft.; RULO = 17 ft. M.S.L.

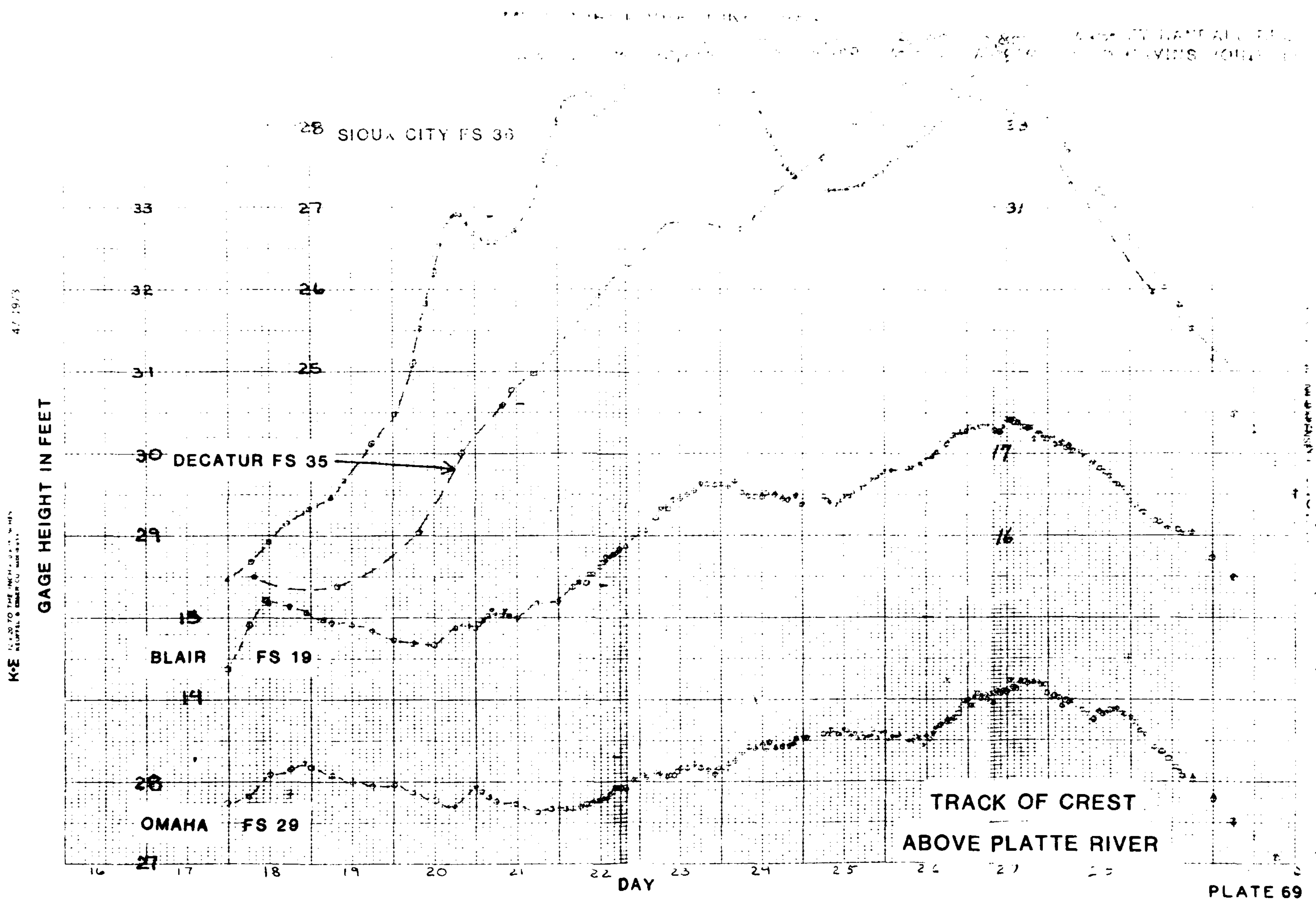
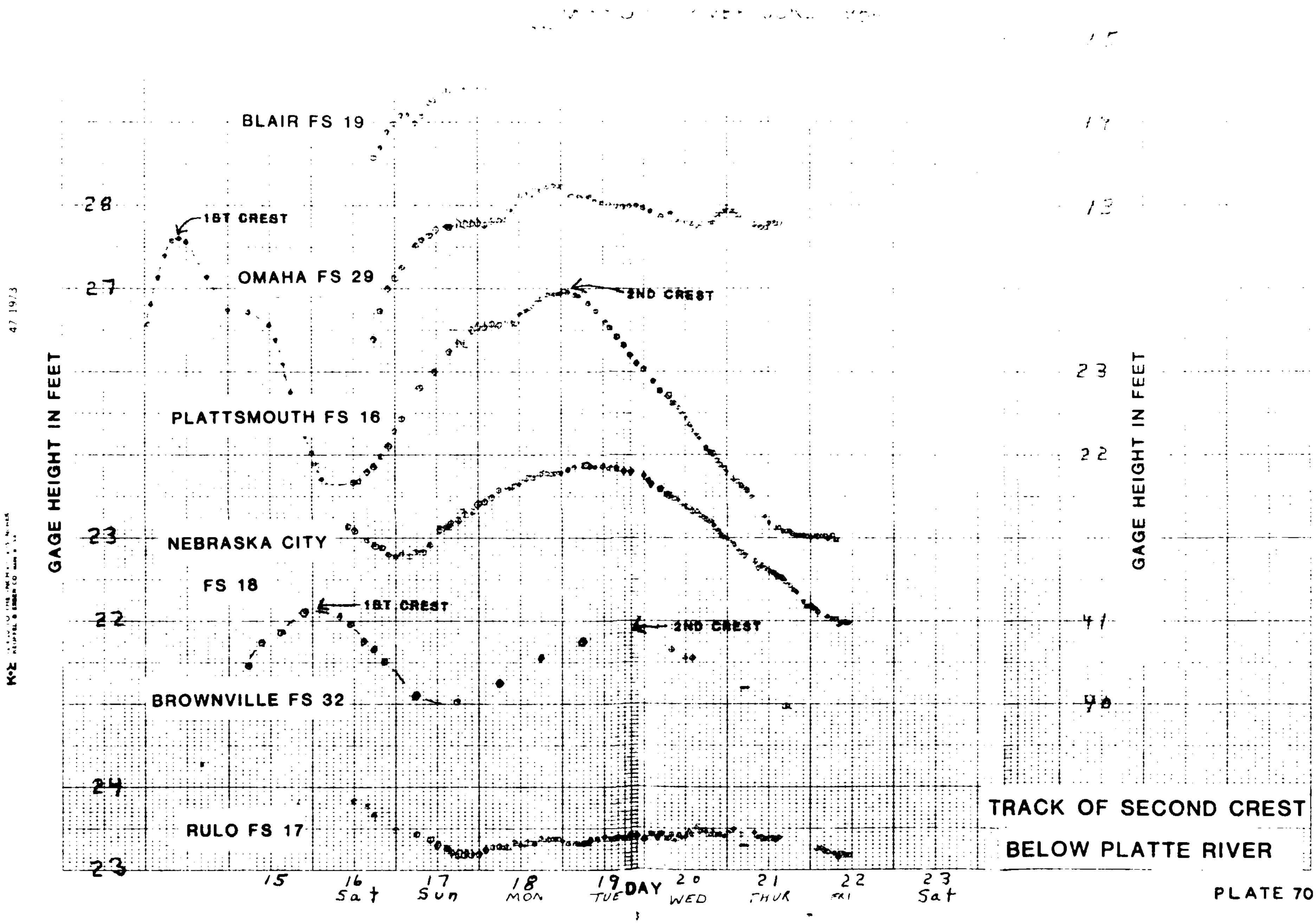

SIOUX CITY FS 36
DECATUR FS 35
BLAIR FS 19
OMAHA FS 29
GAGE HEIGHT IN FEET
DAY
TRACK OF CREST
ABOVE PLATTE RIVER

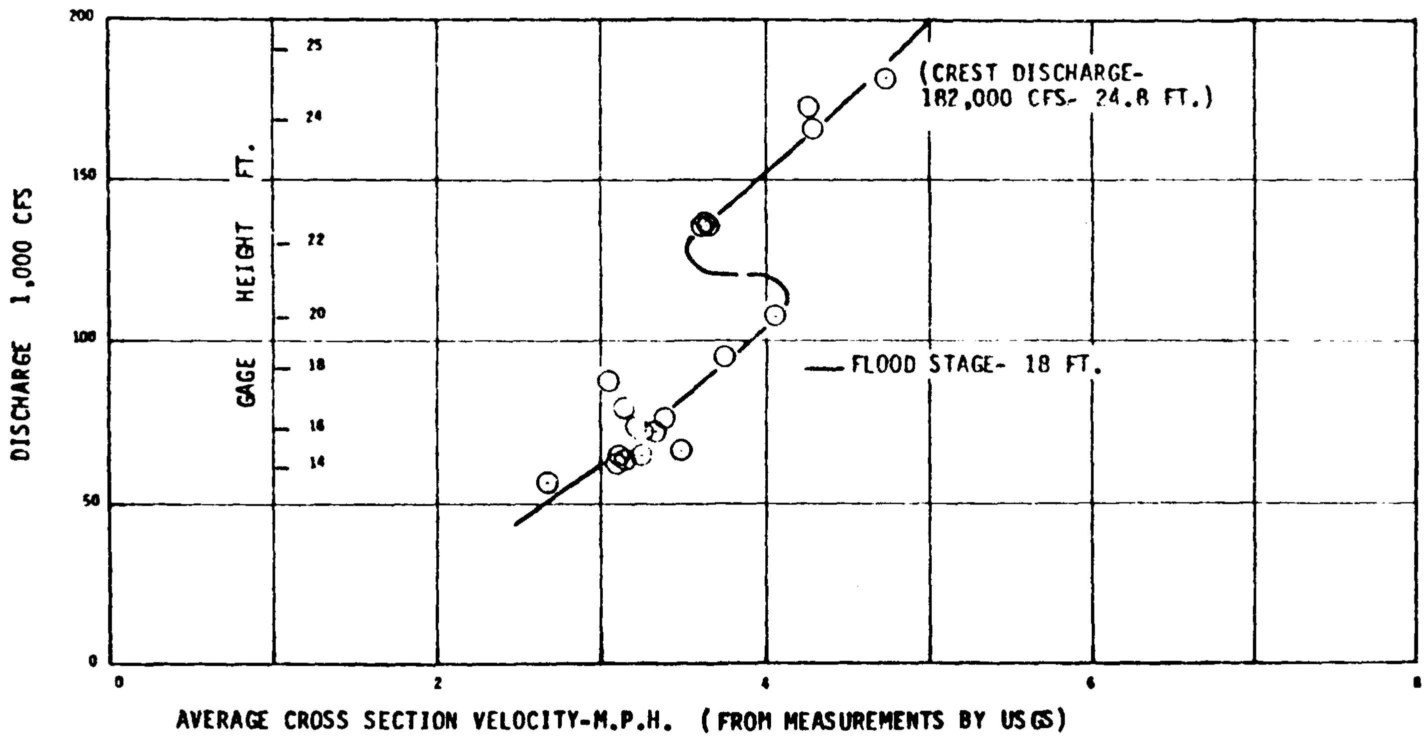
PLATE 69



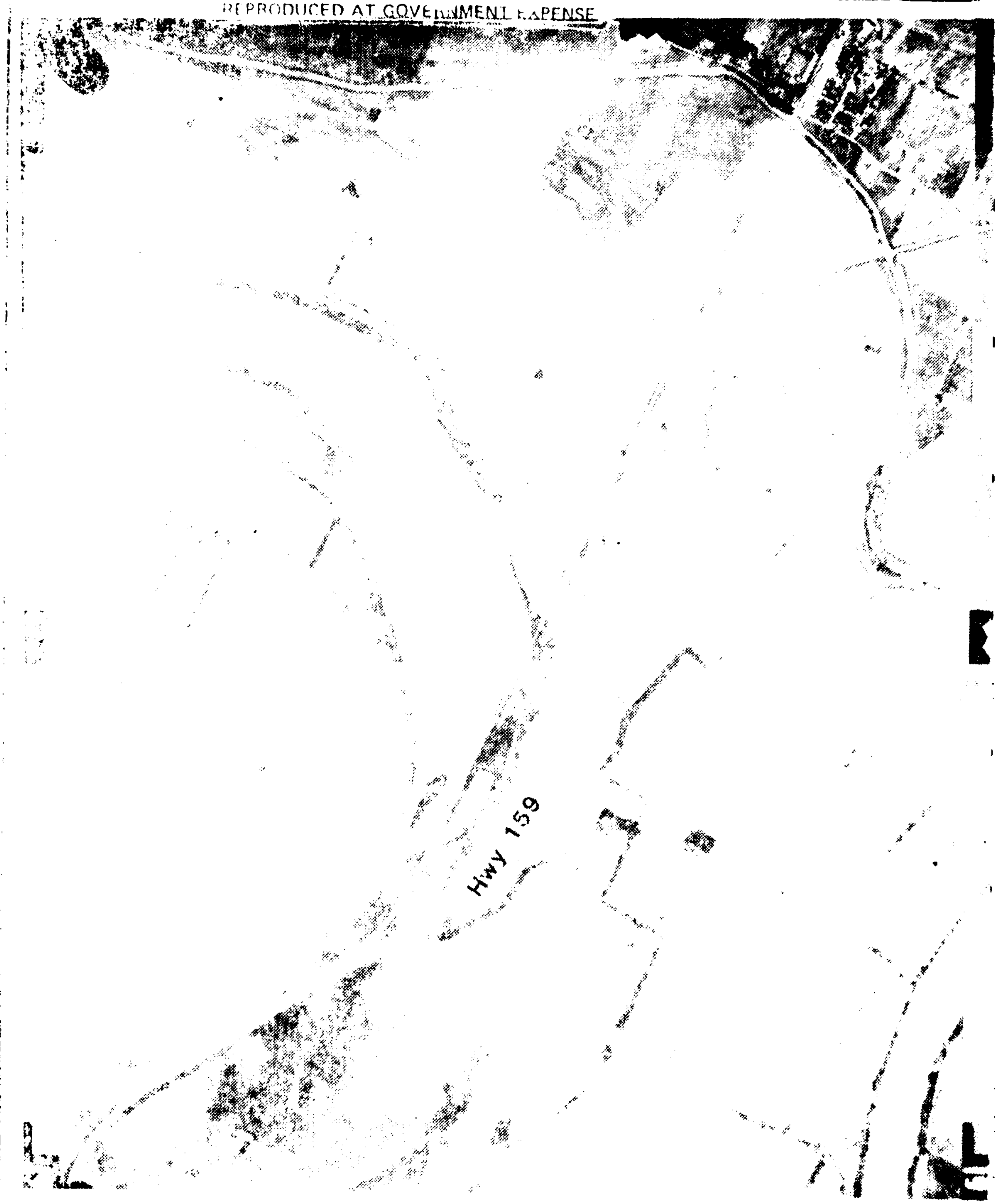
TRACK OF SECOND CREST
BELOW PLATTE RIVER

PLATE 70

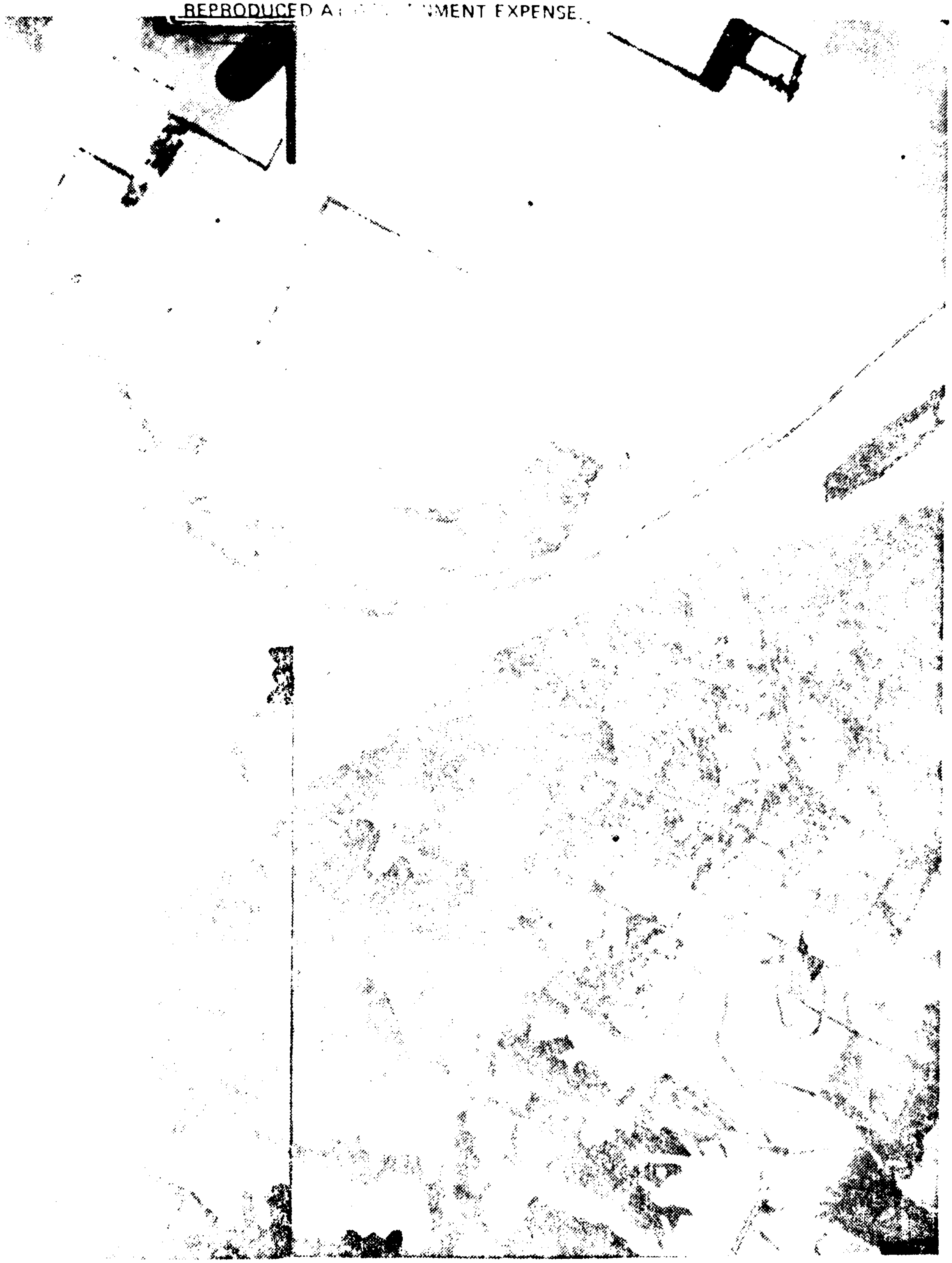
NOTE: MISSOURI RIVER CREST BETWEEN PLATTSMOUTH AND RULO MOVED APPROXIMATELY 2.5 MPH



RIVER VELOCTIY VS. DISCHARGE
NEBRASKA CITY
1984


Hwy 159


Missouri River



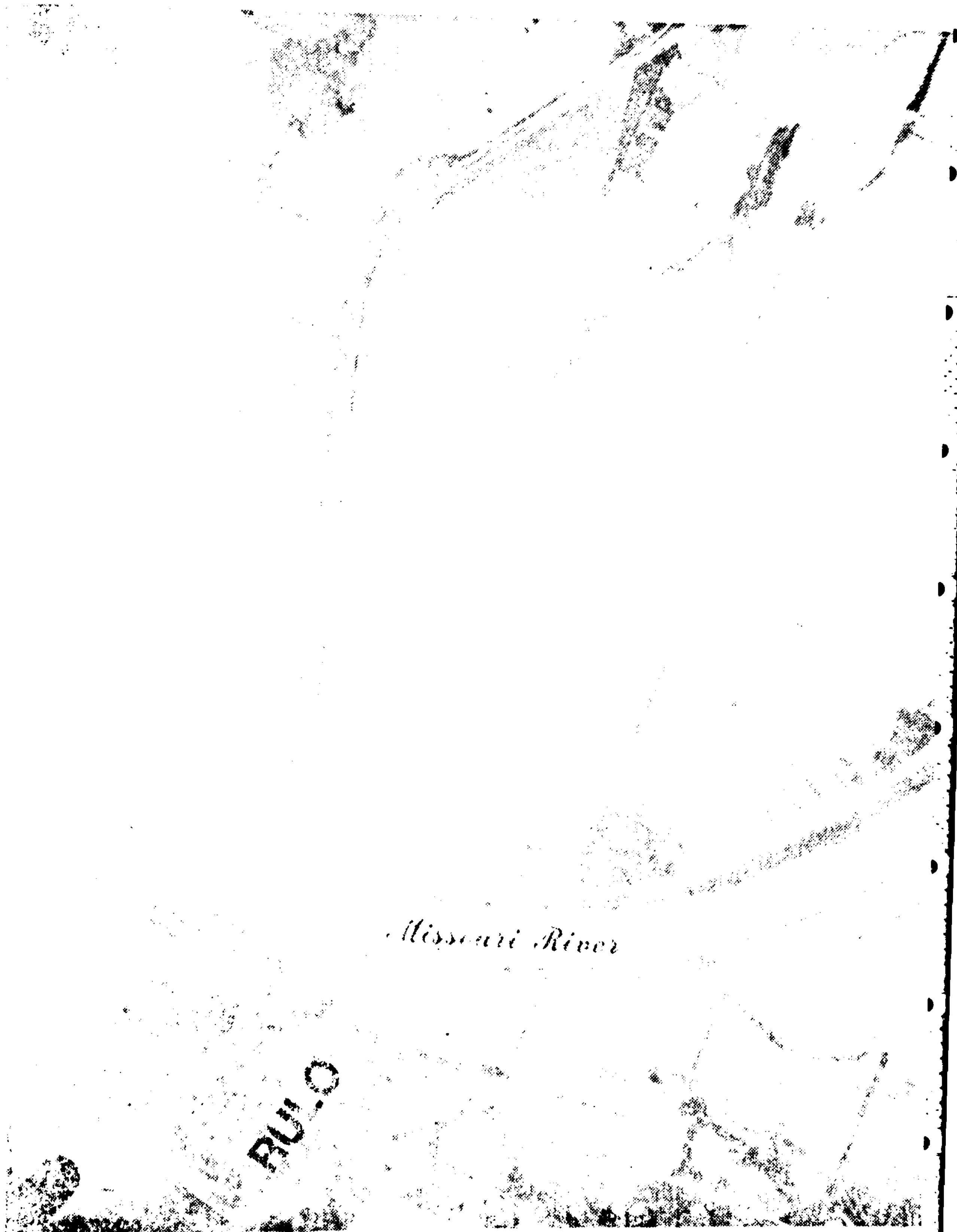
MISSOURI RIVER AND TRIBUTARIES

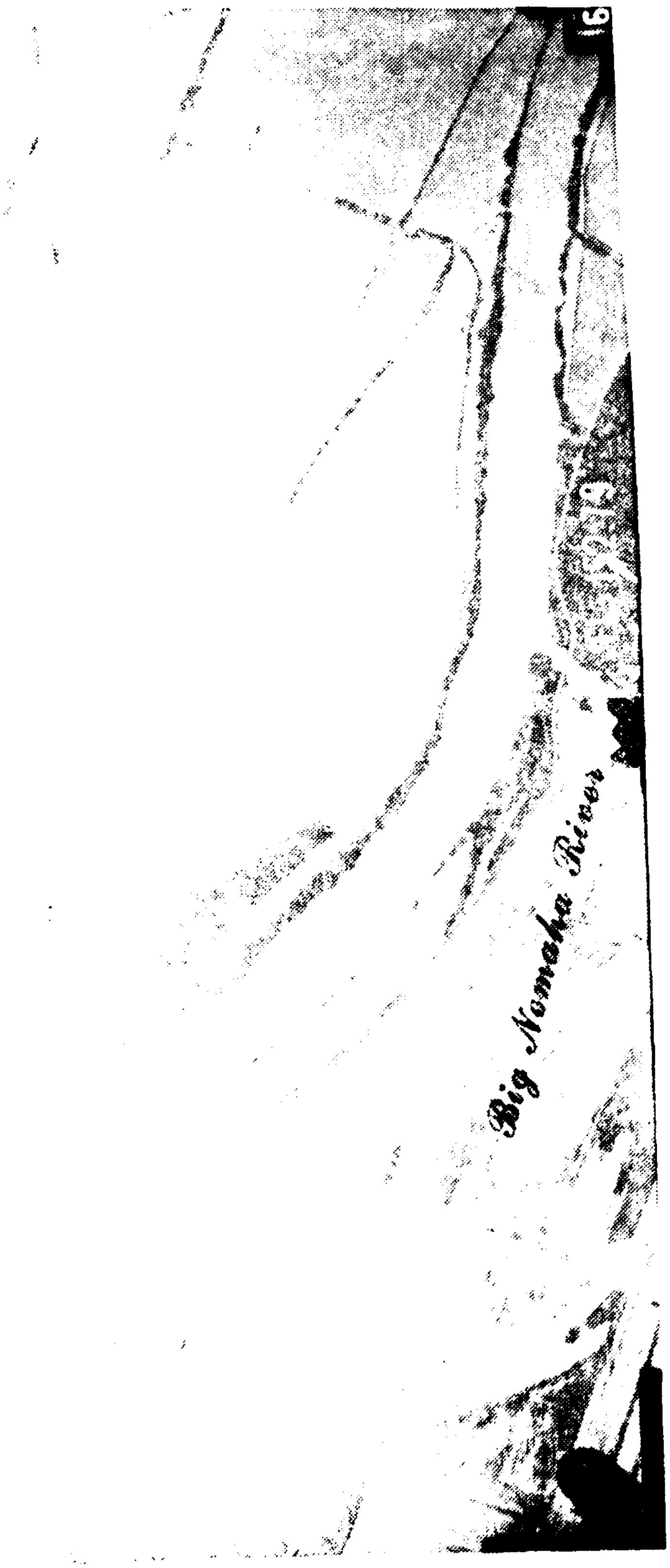
SPRING FLOOD 1984

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

PLATE 72


Winnebago Creek
N

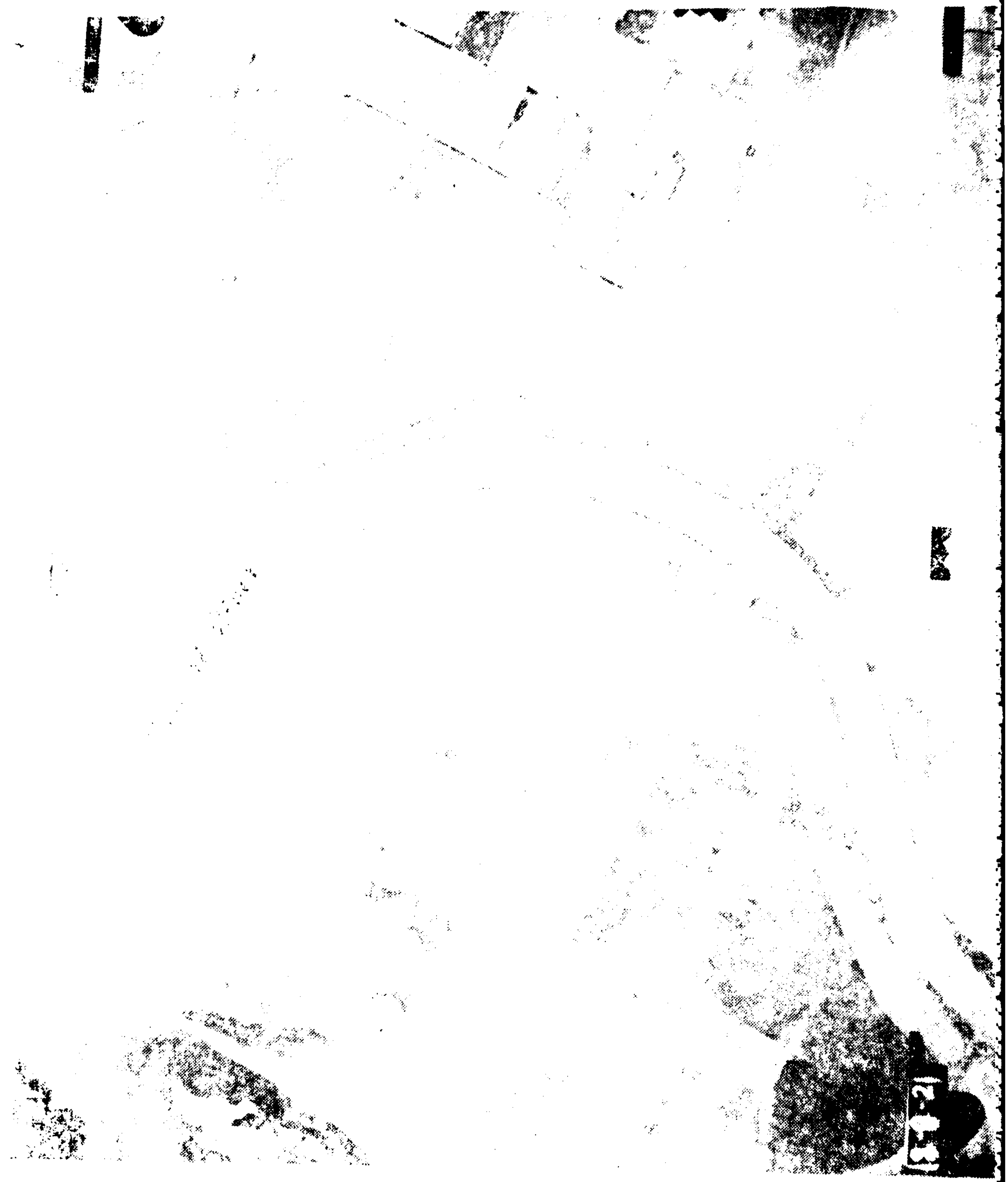

Missouri River
RULO



MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

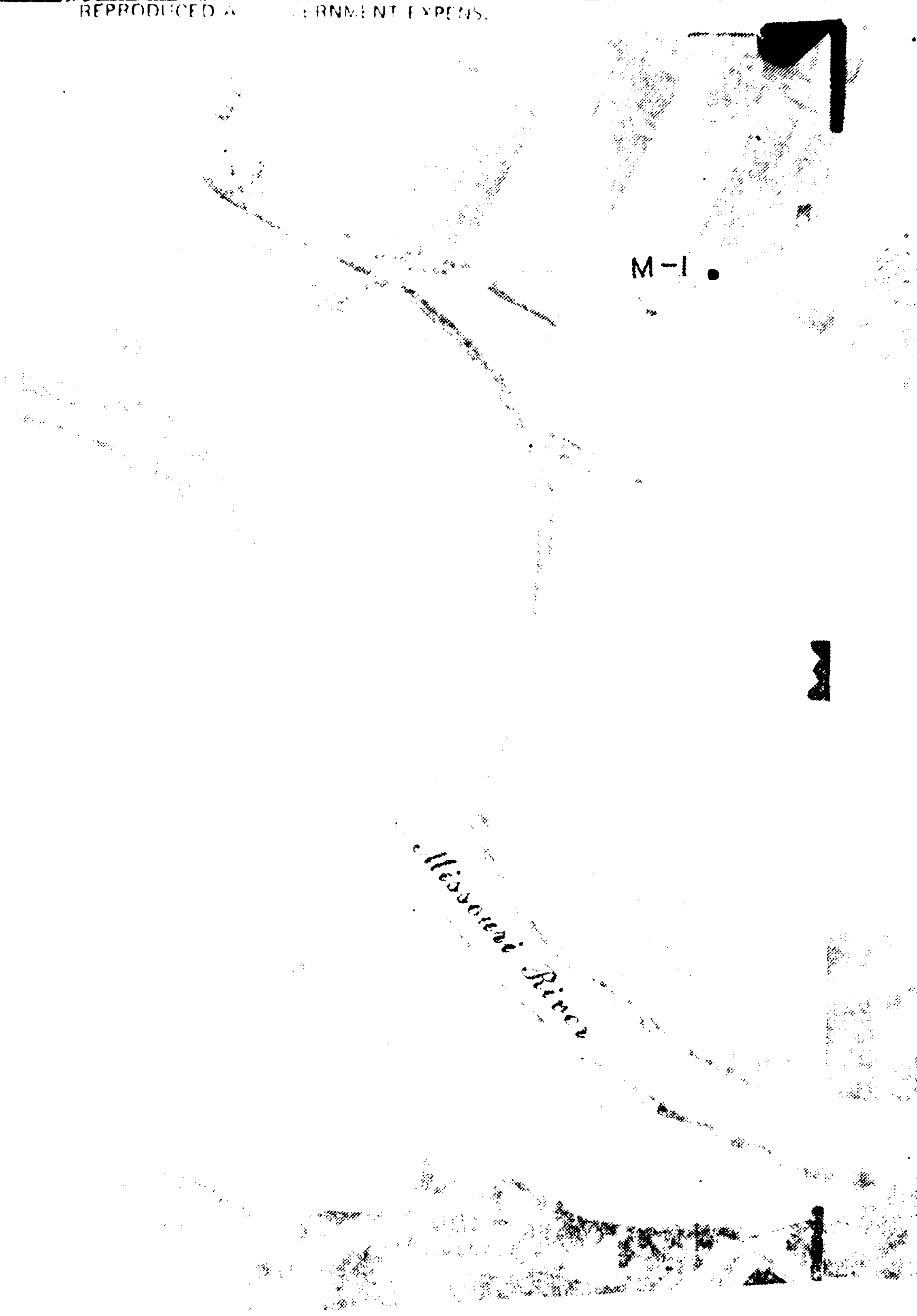


MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984


CORNING


M-1
Missouri River

MISSOURI RIVER AND TRIBUTARIES

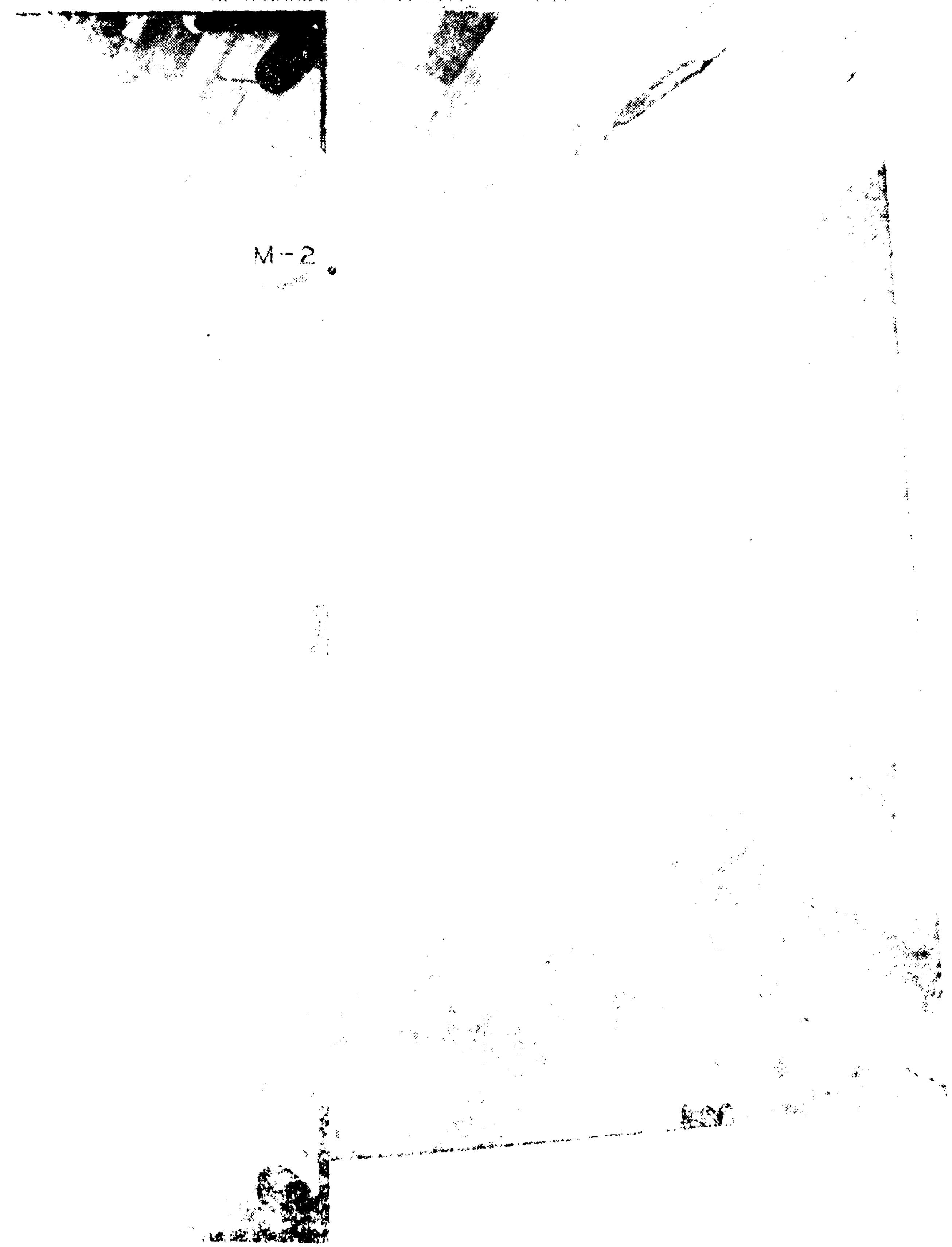
SPRING FLOOD 1984

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

PLATE 75


Missouri
M-3
Morgan Island


Boulder Creek

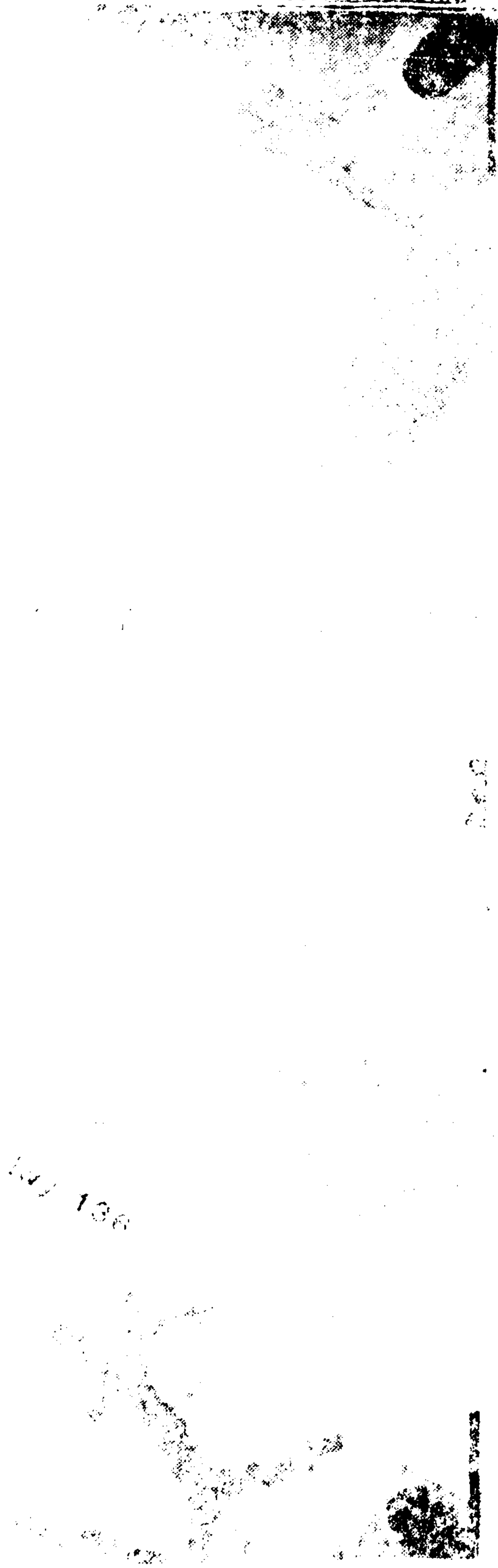


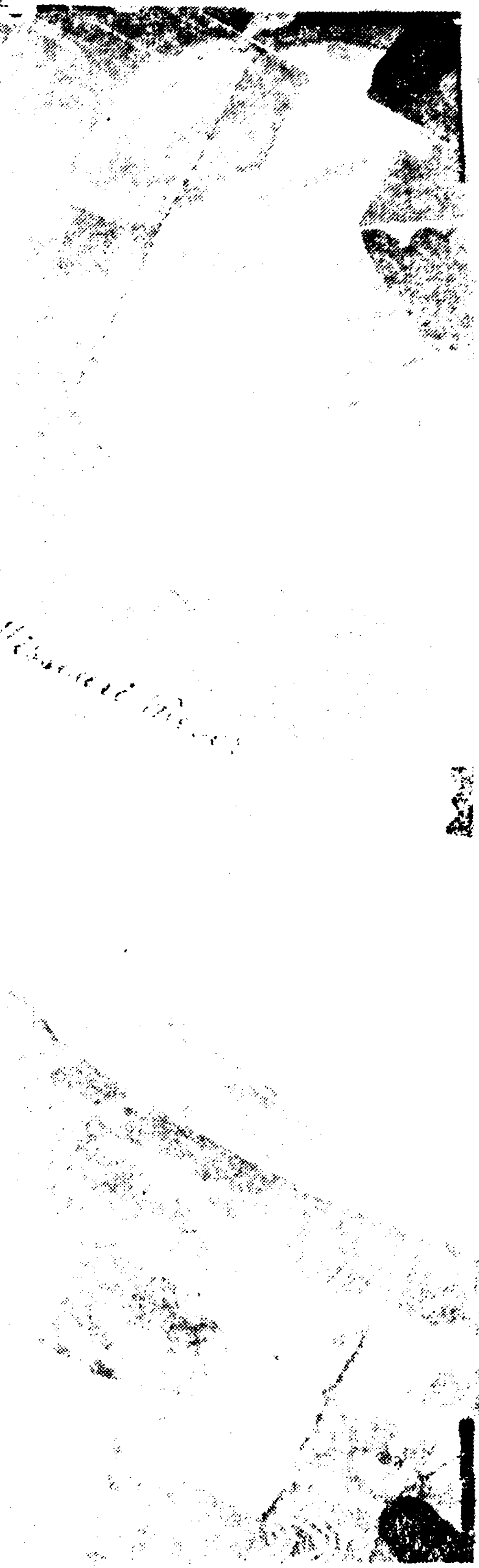
MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT 1984


BROWNVILLE





MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

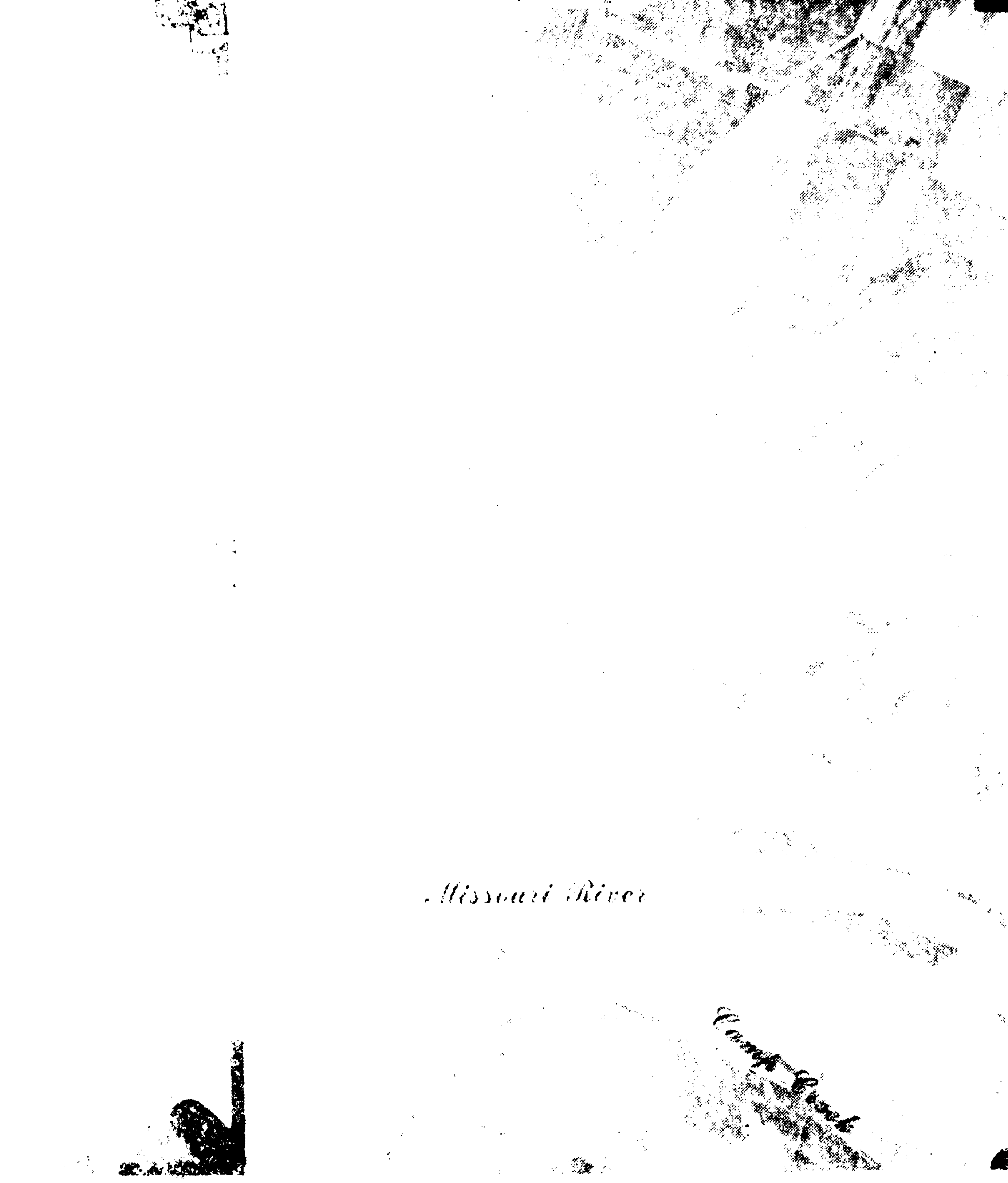
O 542

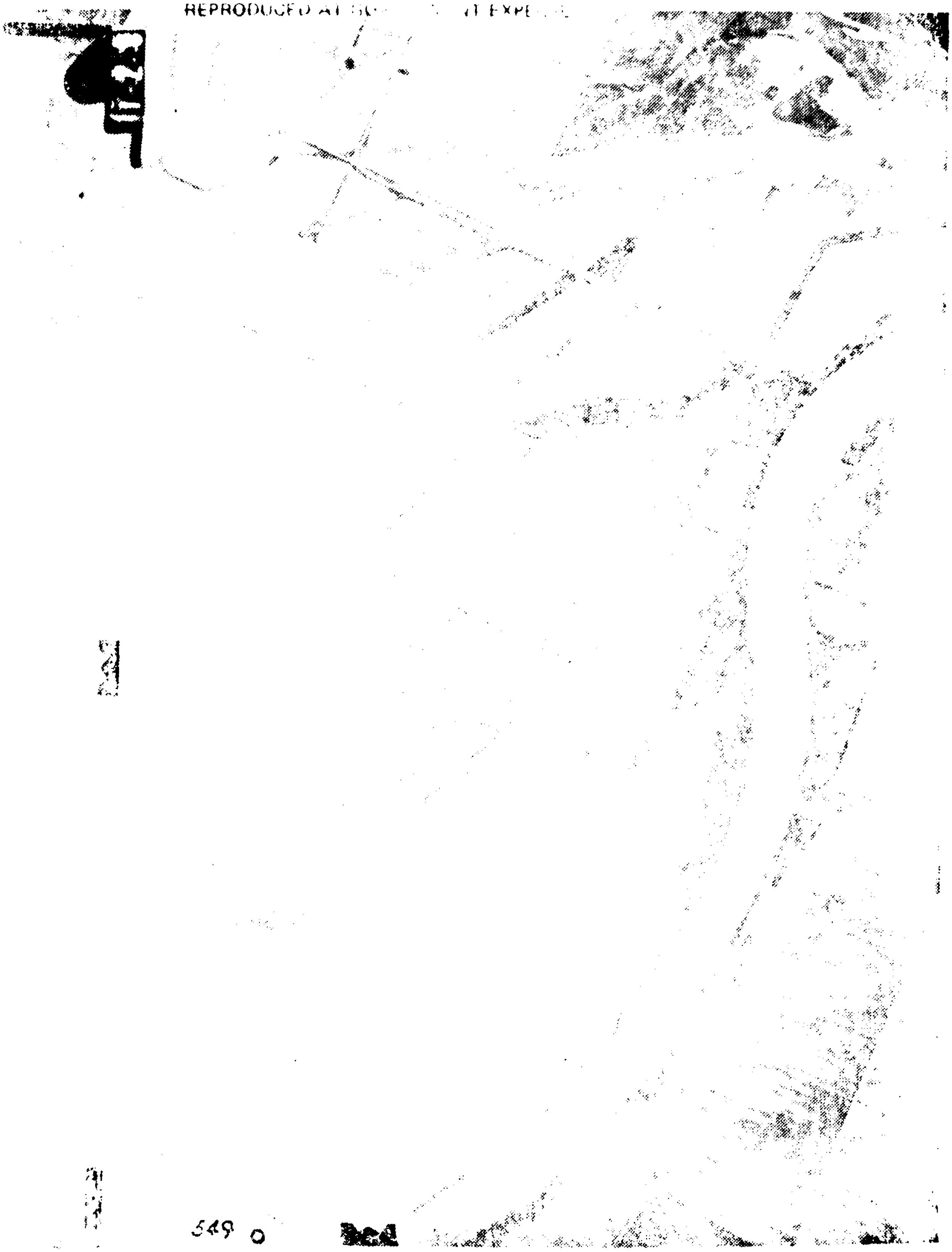
MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984


ommel Island


Missouri River
Camp Creek



MISSOURI RIVER AND TRIBUTAR

SPRING FLOOD 1984

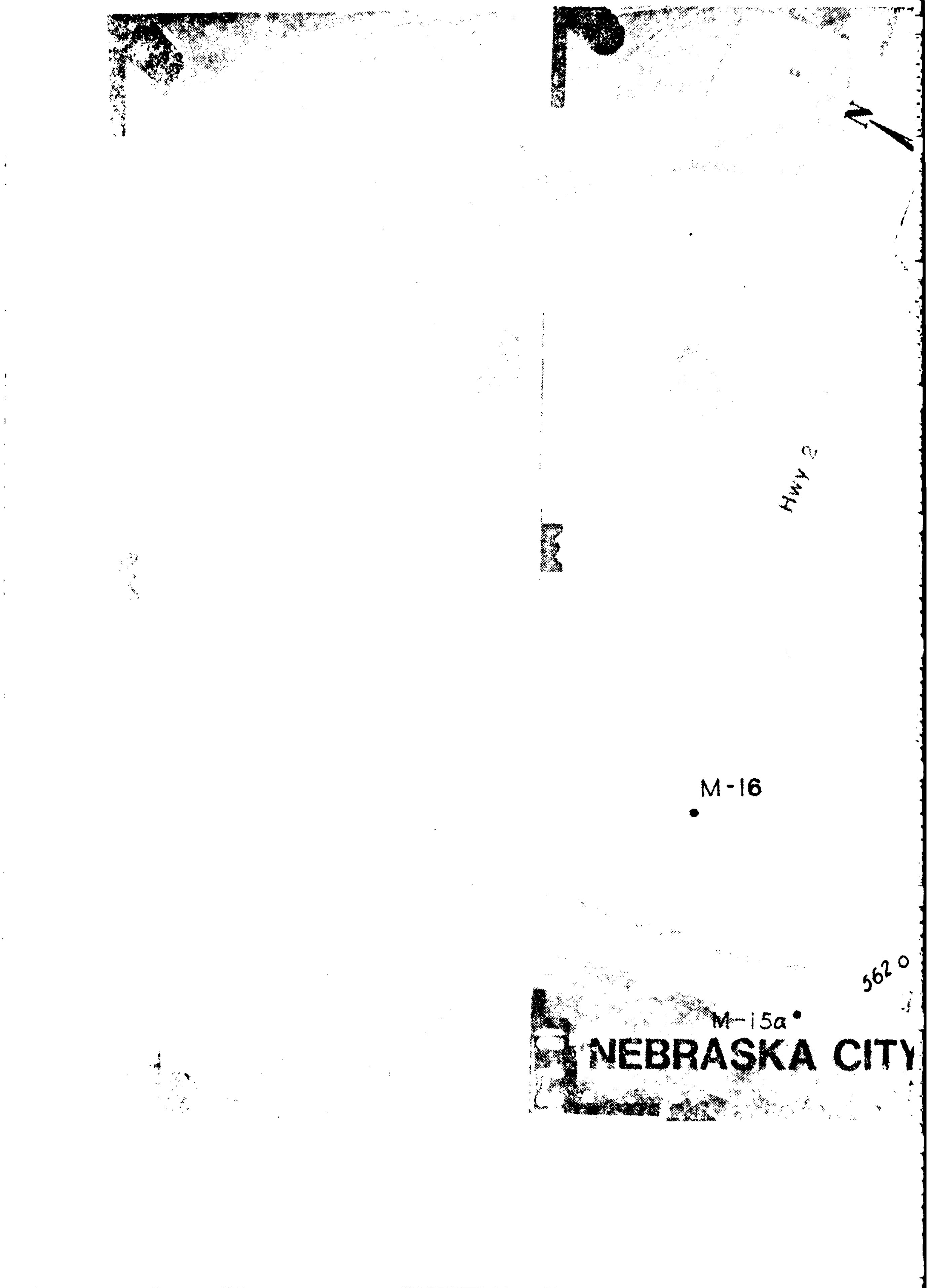
U. S. ARMY ENGINEER DISTRICT, O...
CORPS OF ENGINEERS OMAHA, NEBR.
OCT 1984


Missouri River

0 557

MISSOURI RIVER AND TRIBUTARIES
SPRING FLOOD 1984

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT 1984

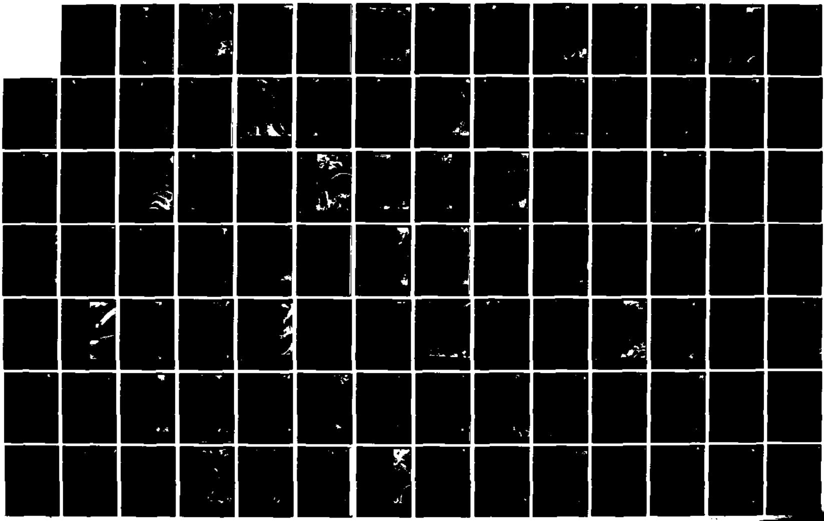

Hwy 2
M-16
M-15a
NEBRASKA CITY

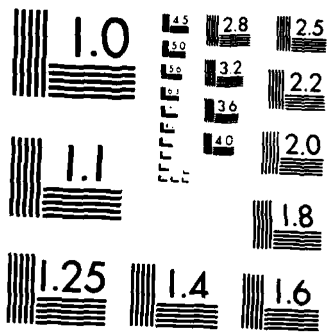
M-14

M-15

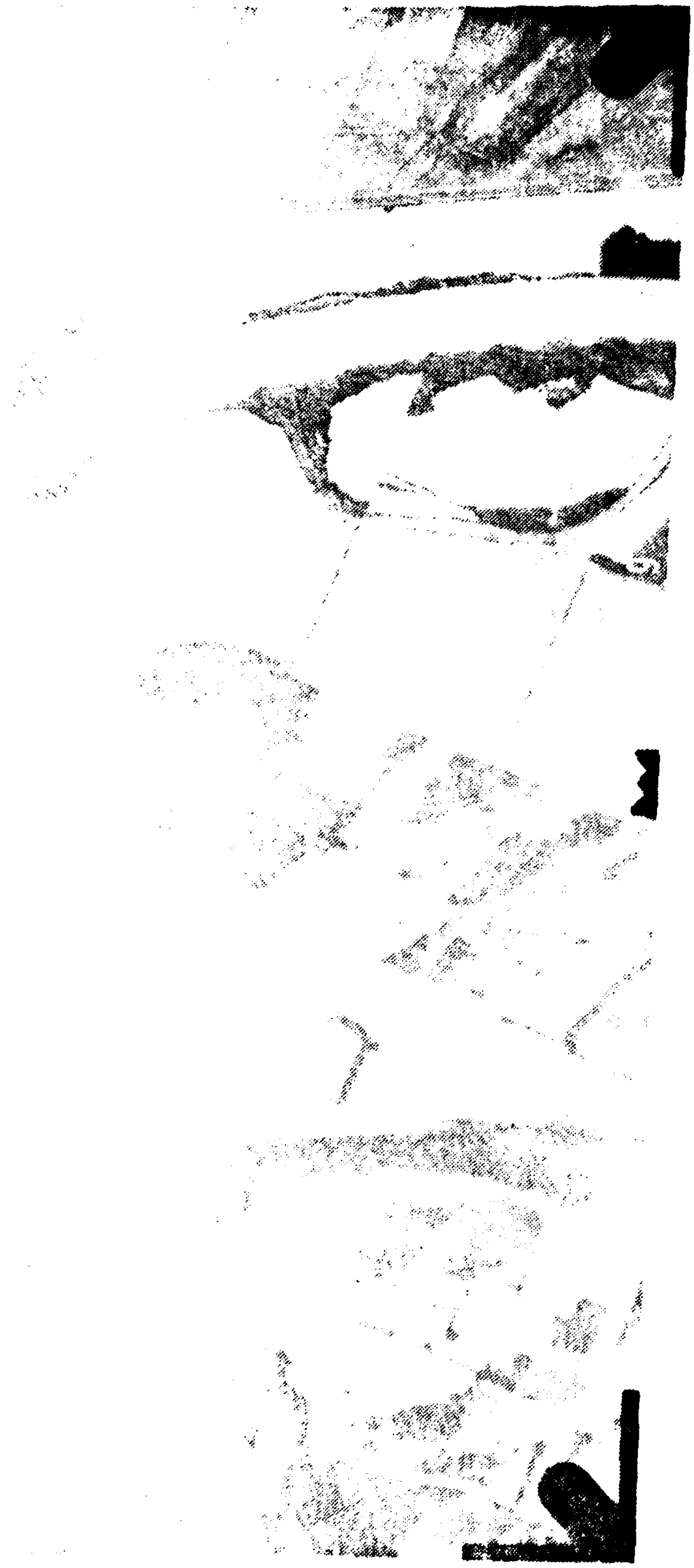
AD-A149 541 POST-FLOOD REPORT MISSOURI RIVER AND TRIBUTARIES SPRING FLOODS 1984(U) CORPS OF ENGINEERS OMAHA NE OCT 84 3/4

UNCLASSIFIED F/G 8/8 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A



MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U S ARMY ENGINEER DISTRICT, OMA

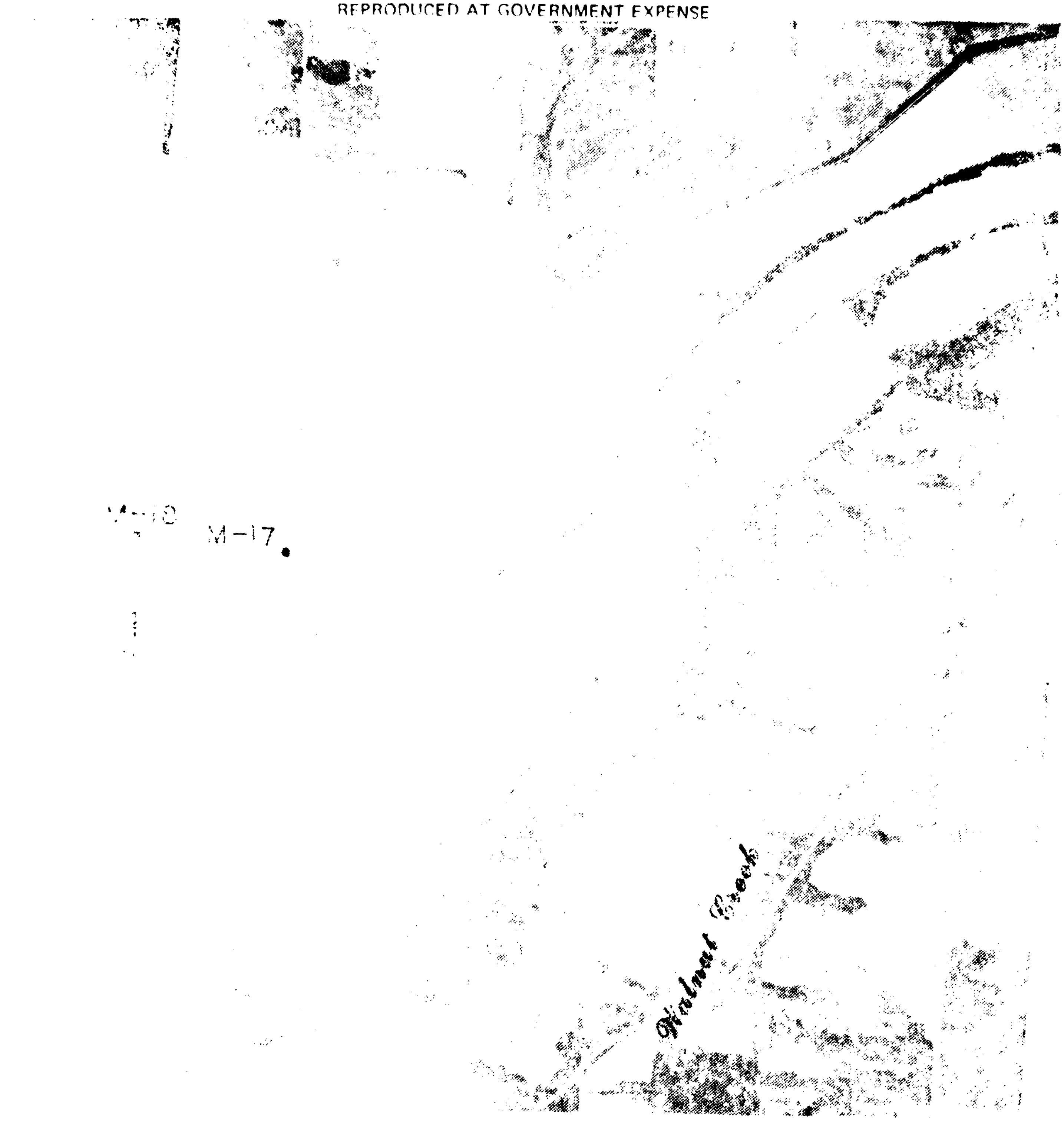
CORPS OF ENGINEERS OMAHA, NEBRAS

OCT. 1984

PLATE


Weeping Water Creek


M-1
Missouri River

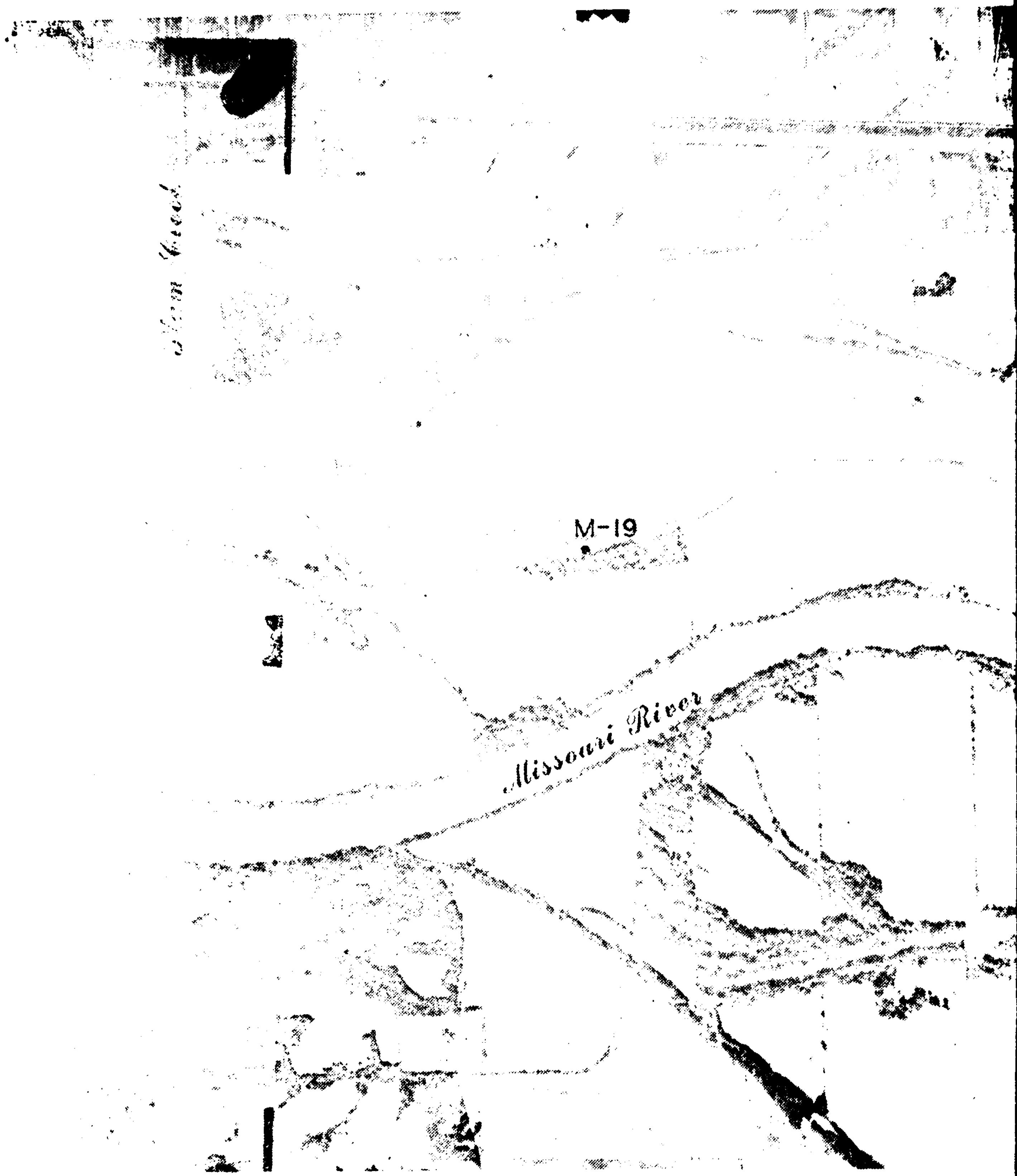


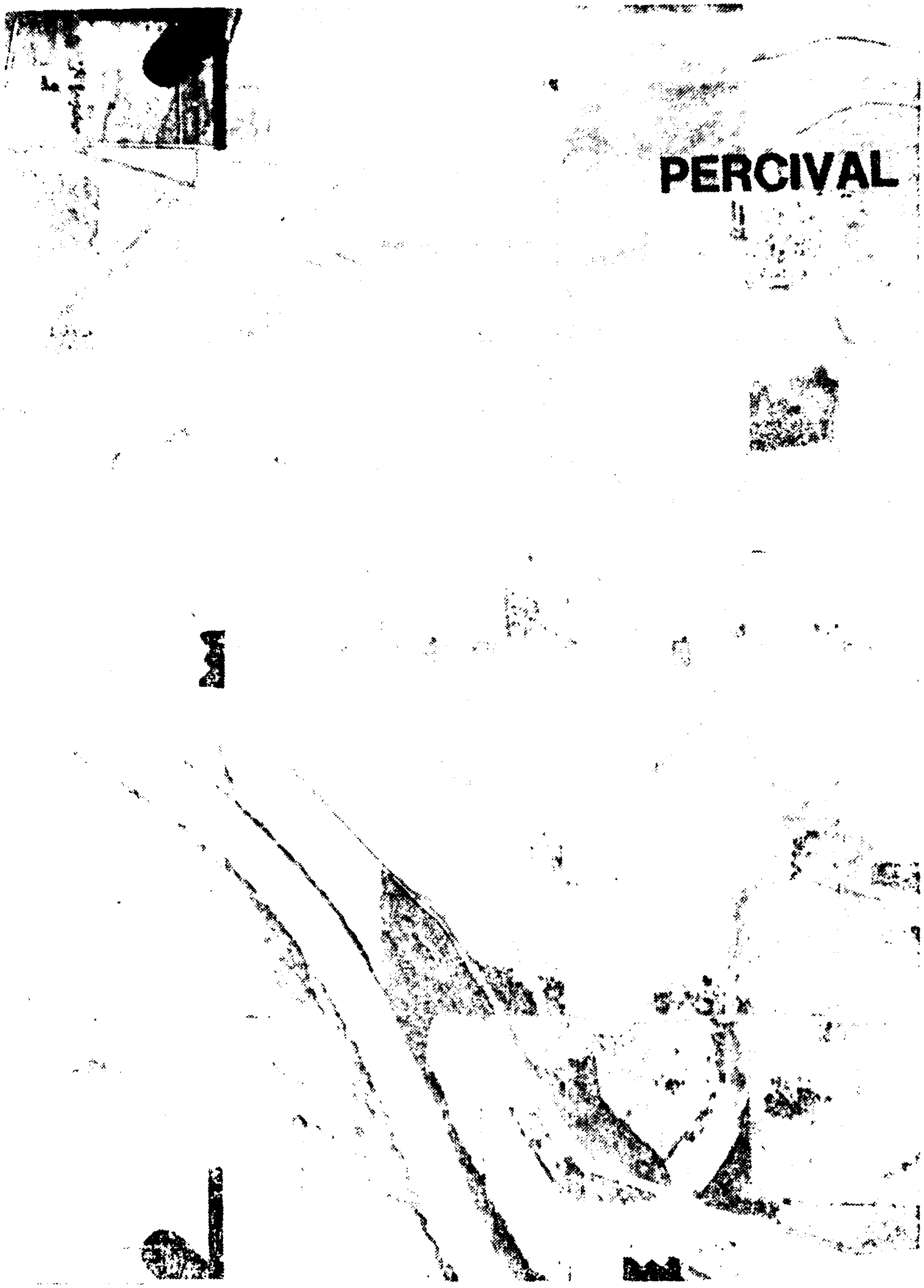
MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984


M-20
Lake


M-19
Missouri River



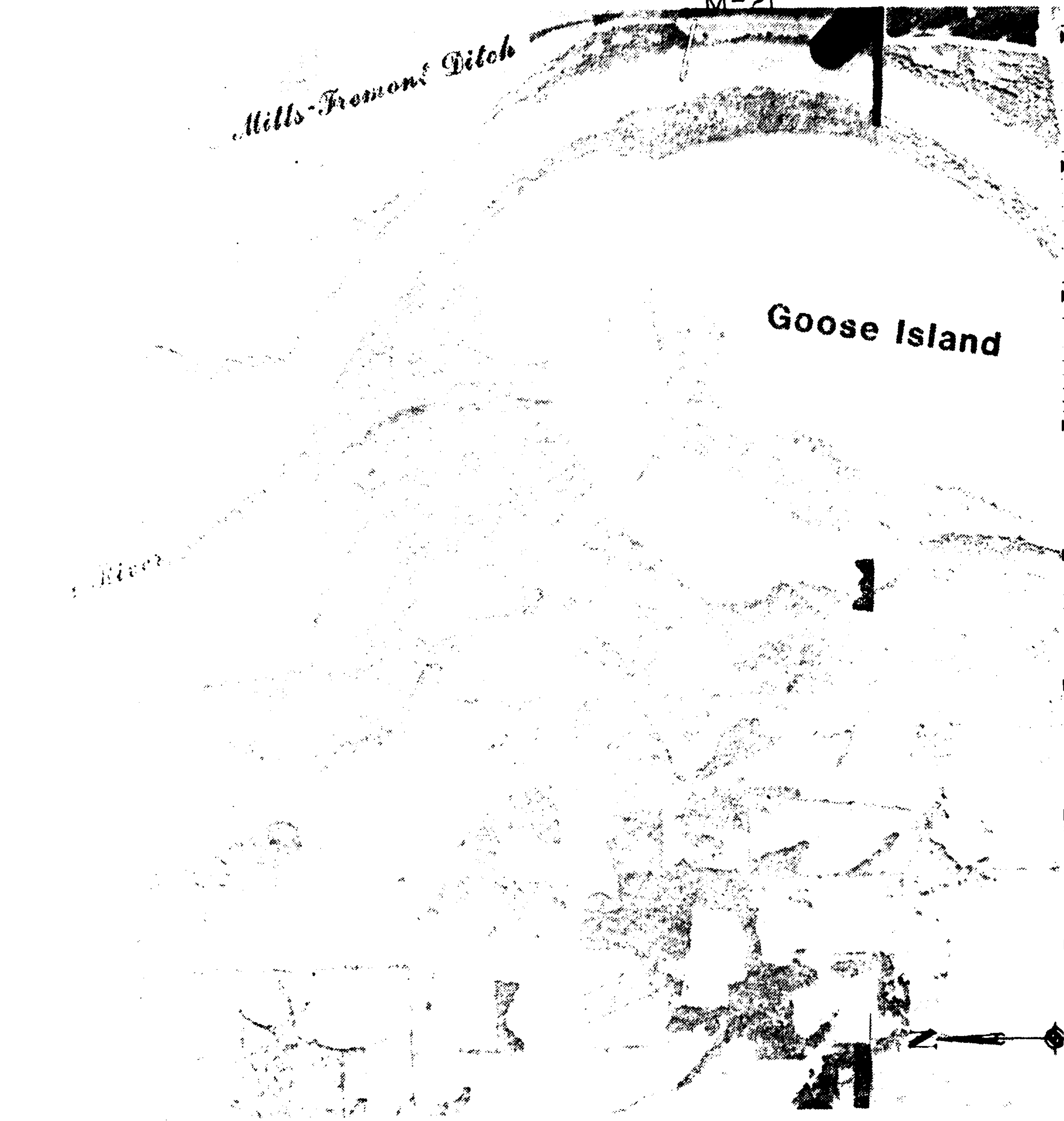
MISSOURI RIVER AND TRIBUTARIES

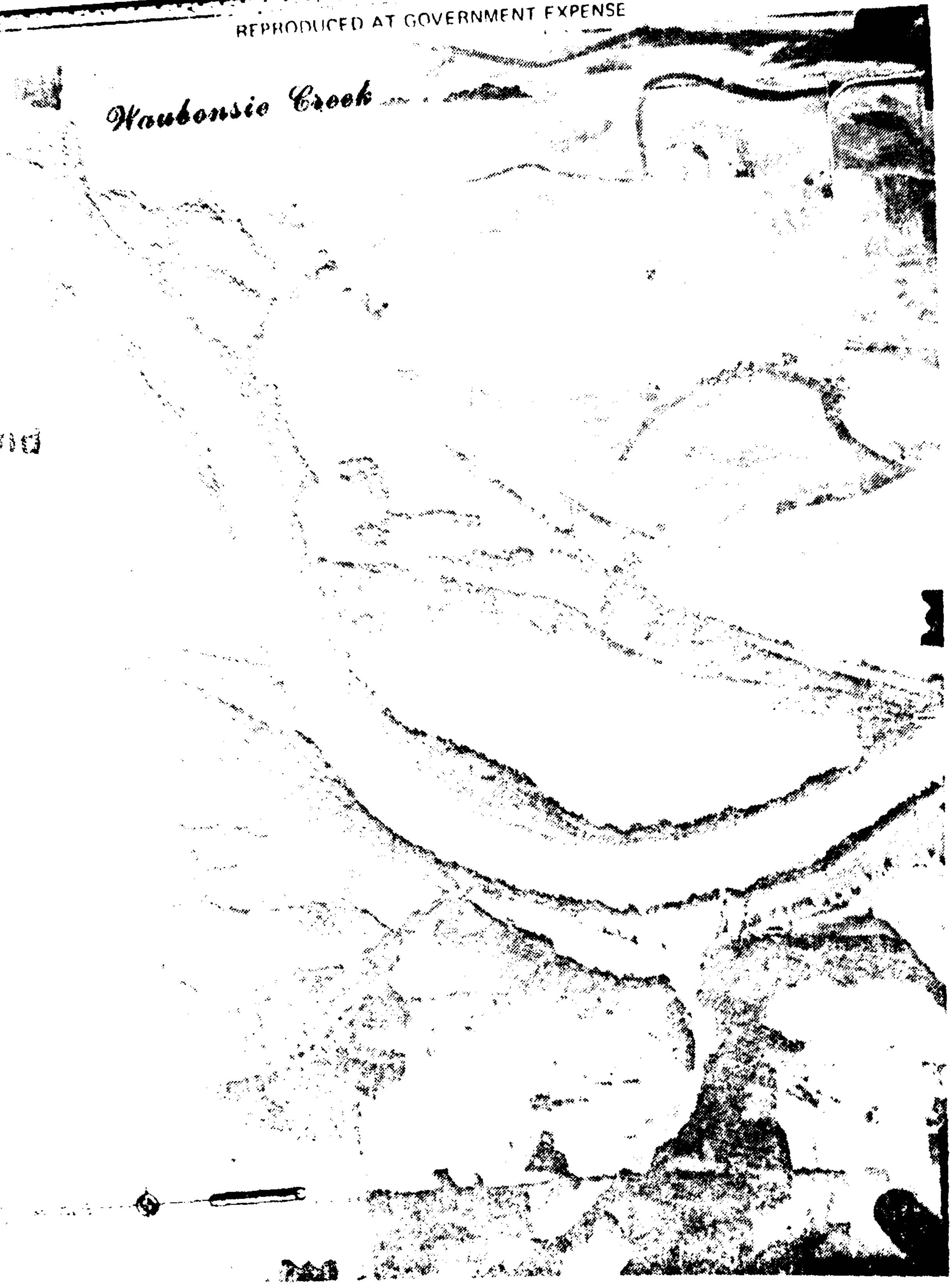
SPRING FLOOD 1984

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

PLATE 83


Missouri River
Rock Creek


Mills-Fremont Ditch
Goose Island
River

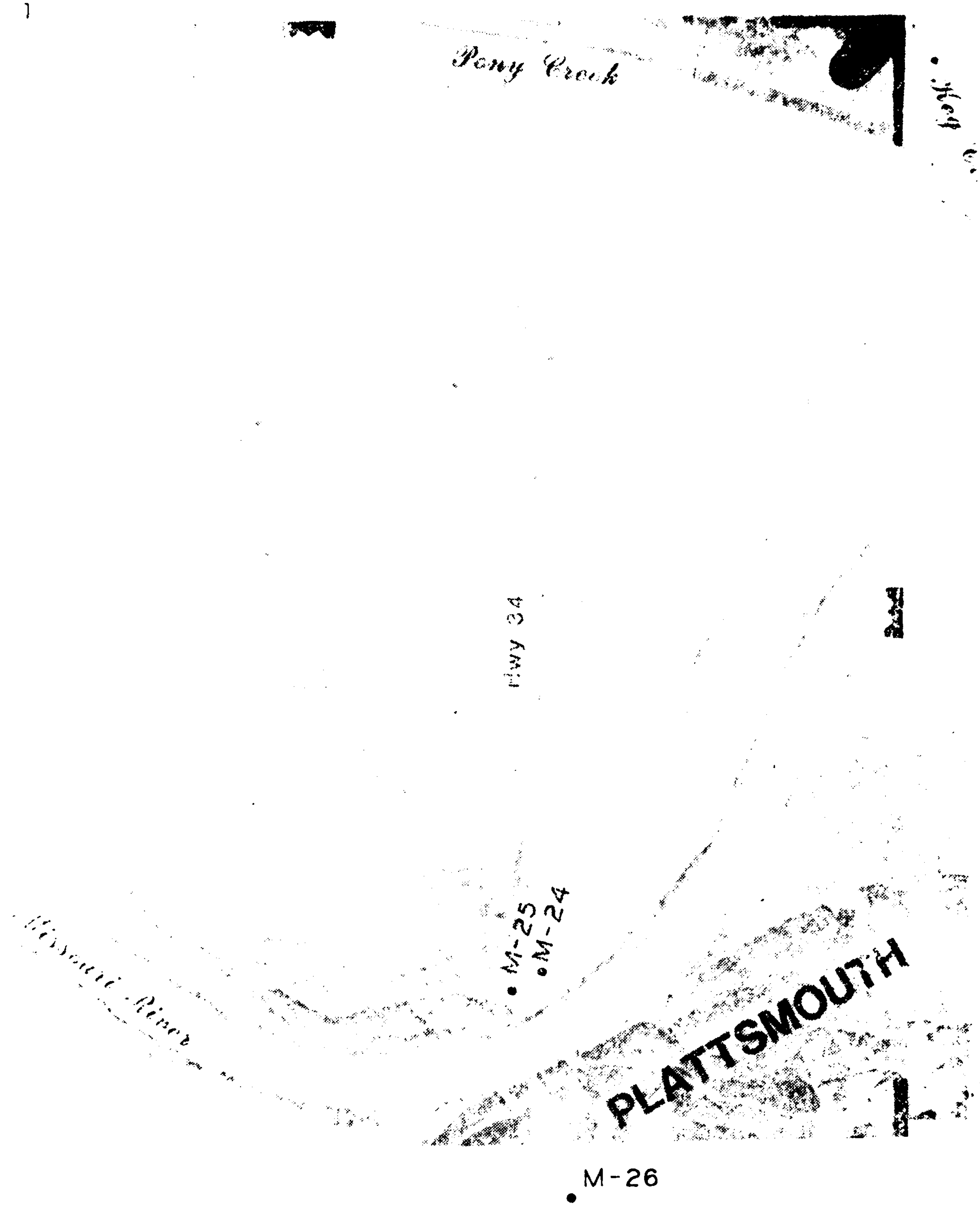


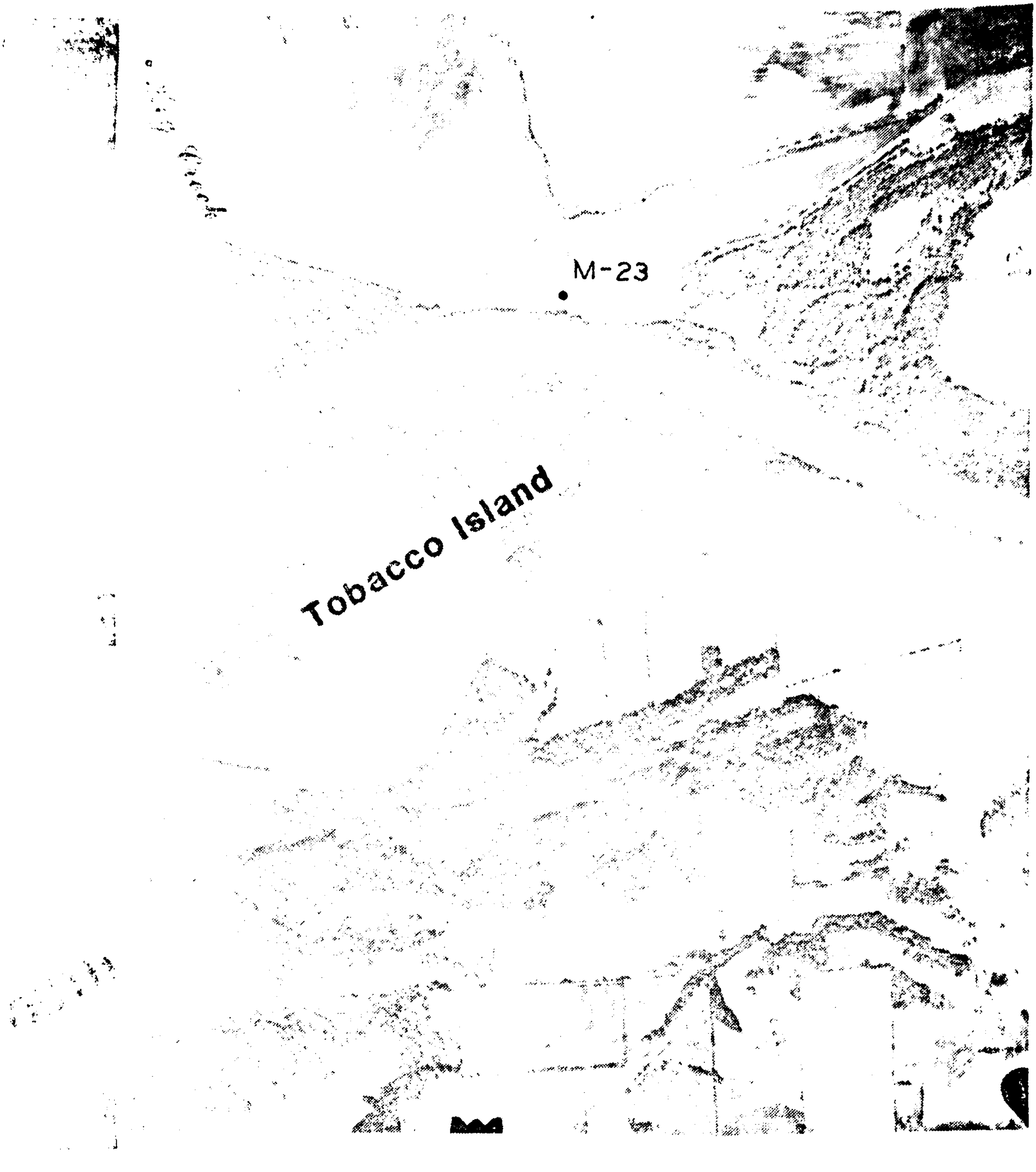
MISSOURI RIVER AND TRIBUTARIES
SPRING FLOOD 1984

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

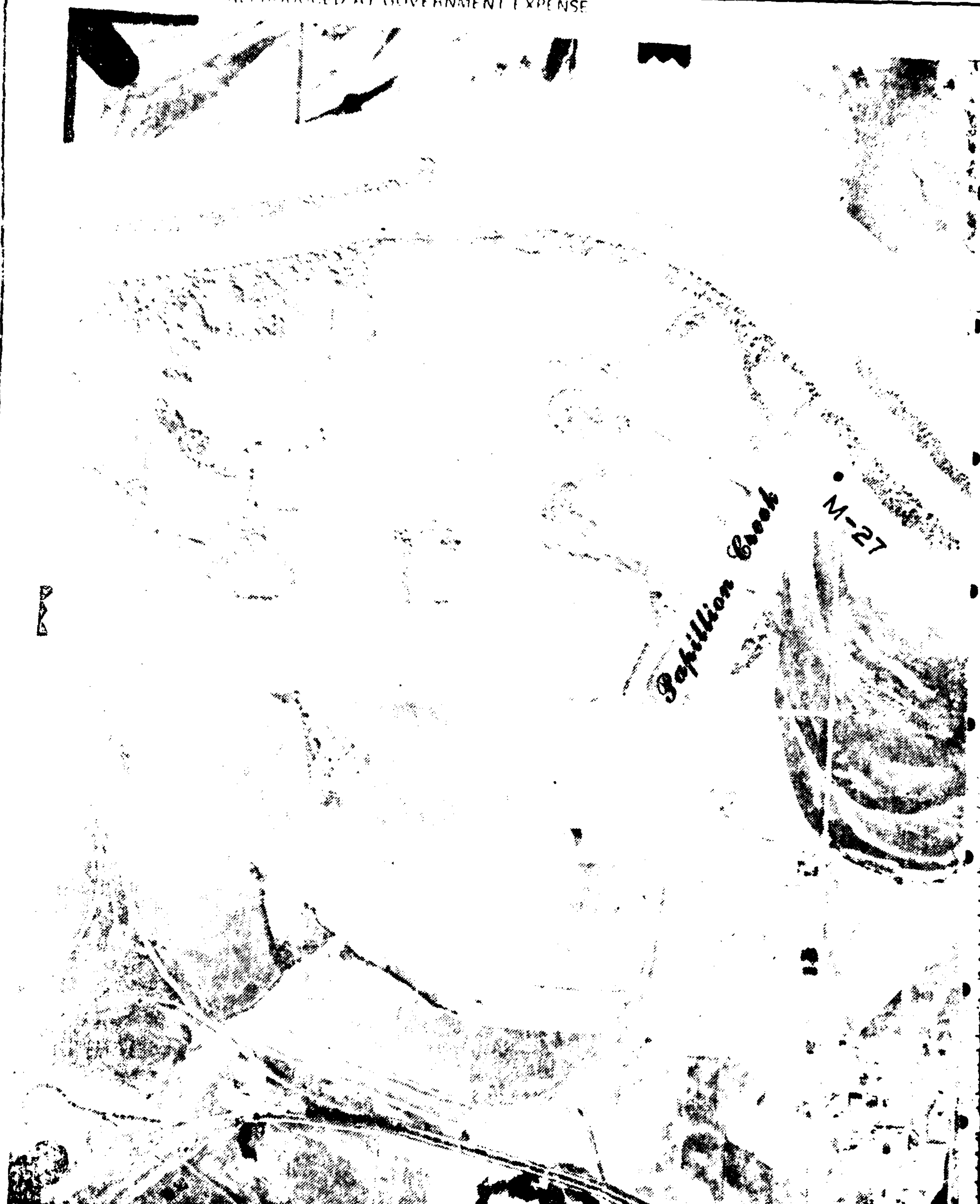
PLATE 34


N
2


Pony Creek
Hwy 34
M-25
M-24
PLATTSMOUTH
M-26



MISSOURI RIVER AND TRIBUTARIES
SPRING FLOOD 1984
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984


Papillion Creek
M-27

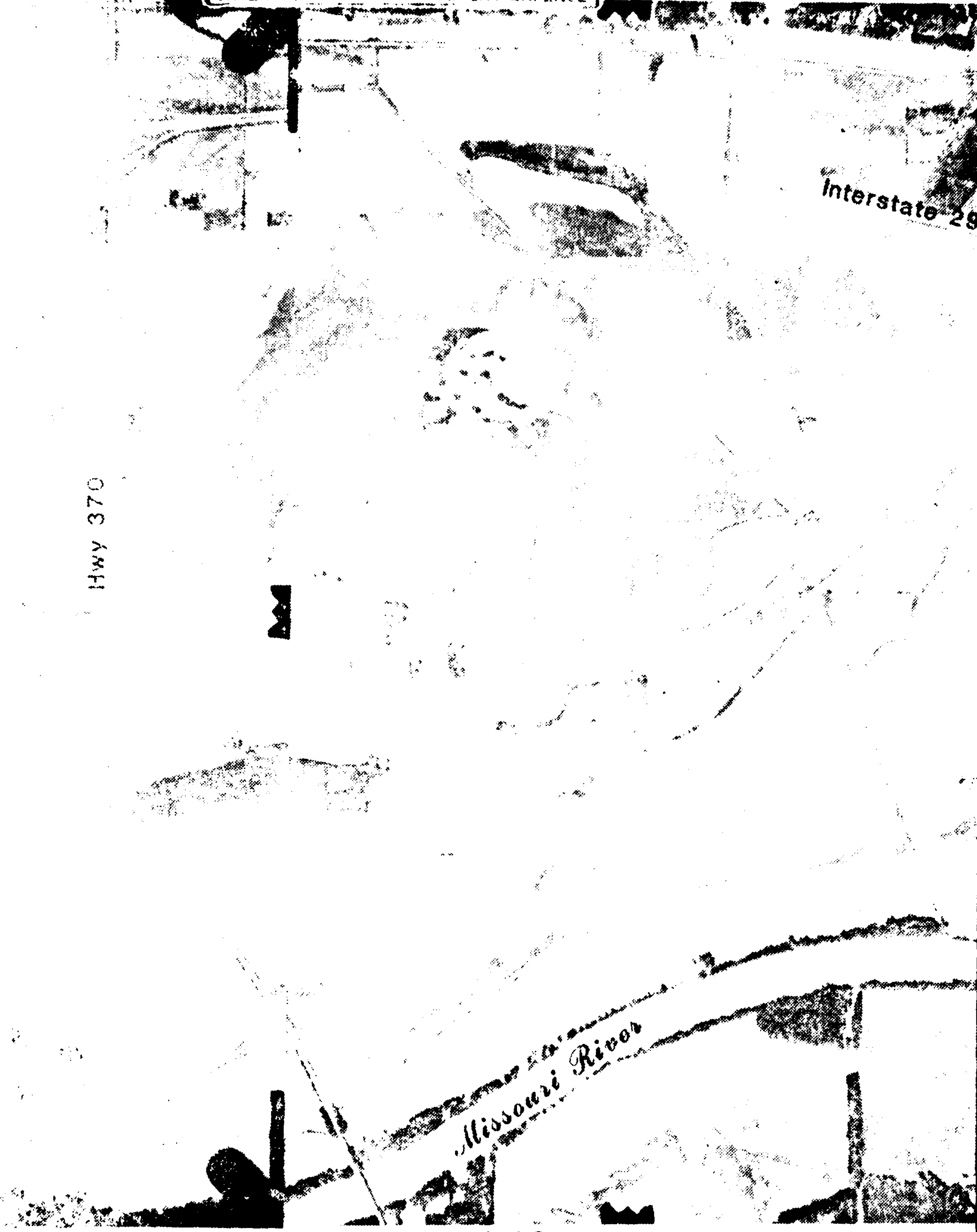

Missouri River
Platte River

MISSOURI RIVER AND TRIBUTARIES

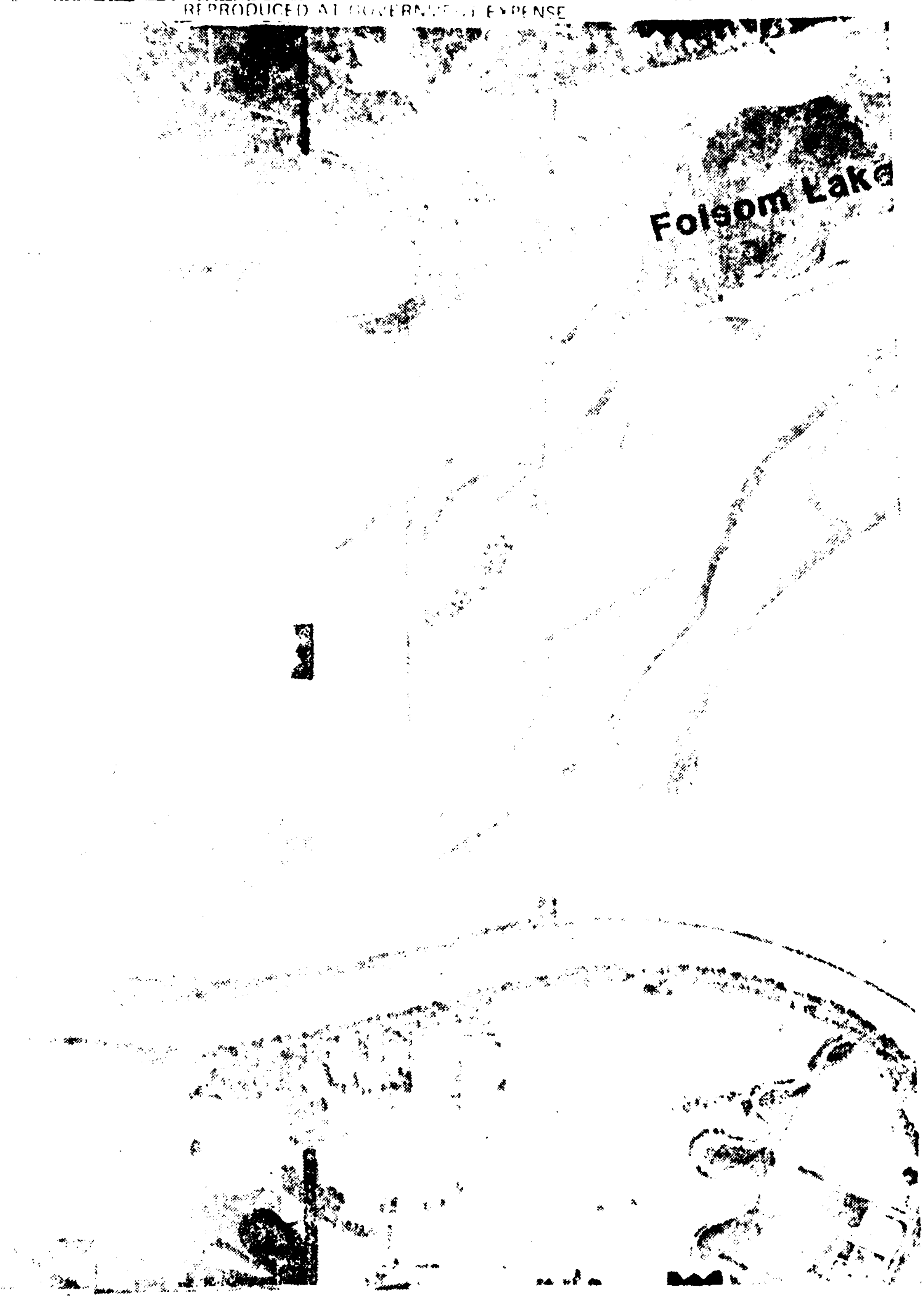
SPRING FLOOD 1984

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984


Mosquito Creek
M-29
606



M-28

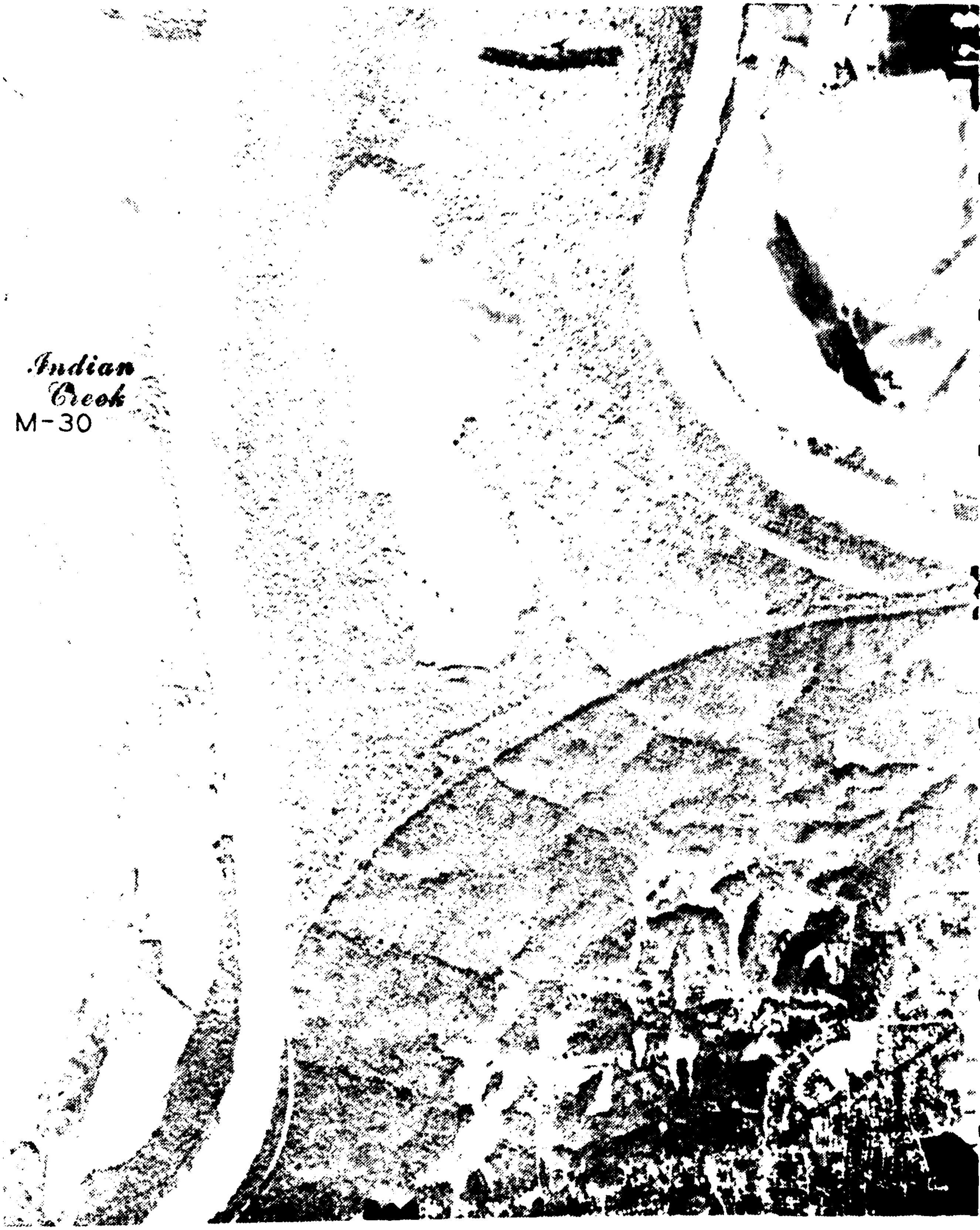


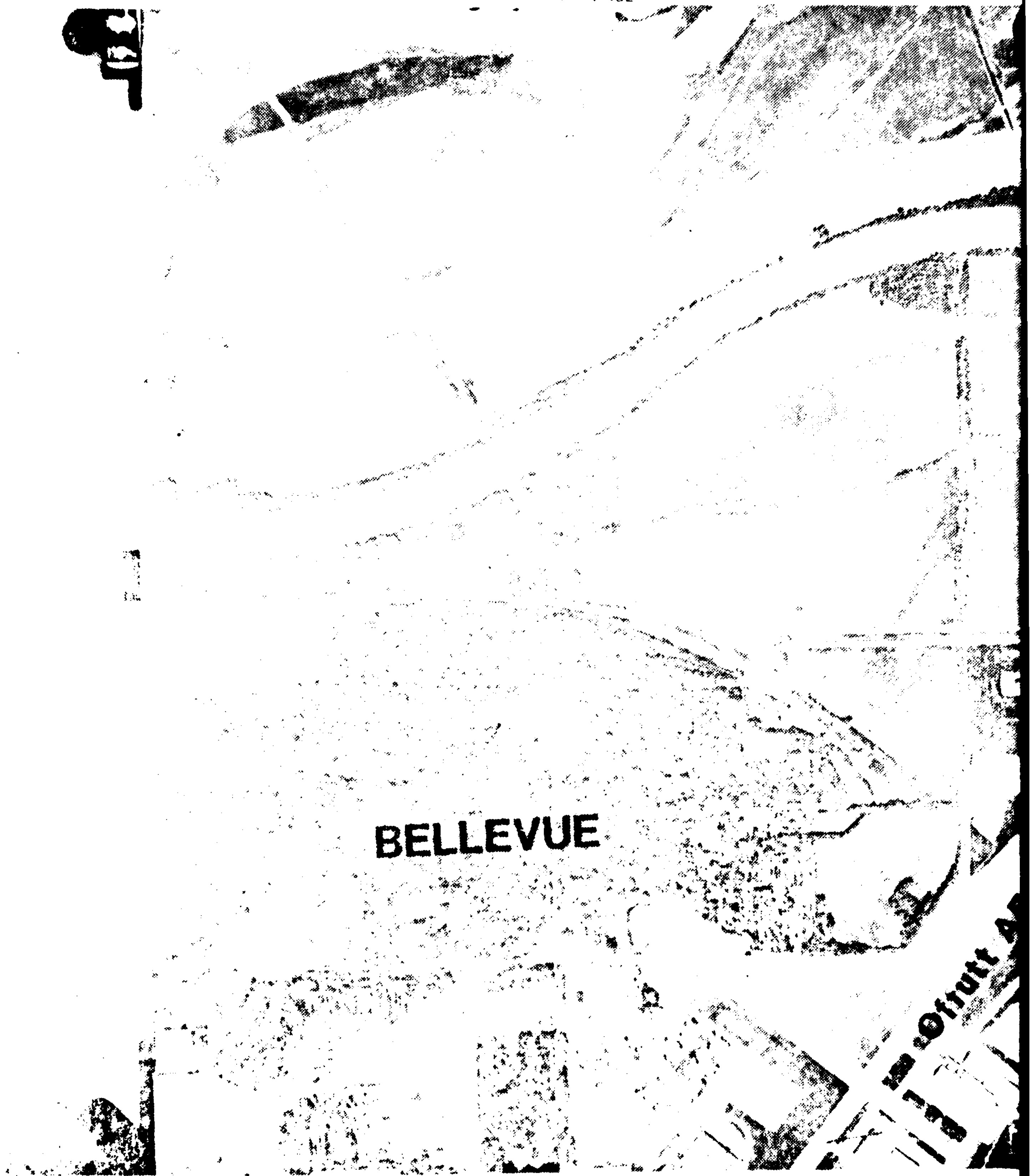
MISSOURI RIVER AND TRIBUTARIES

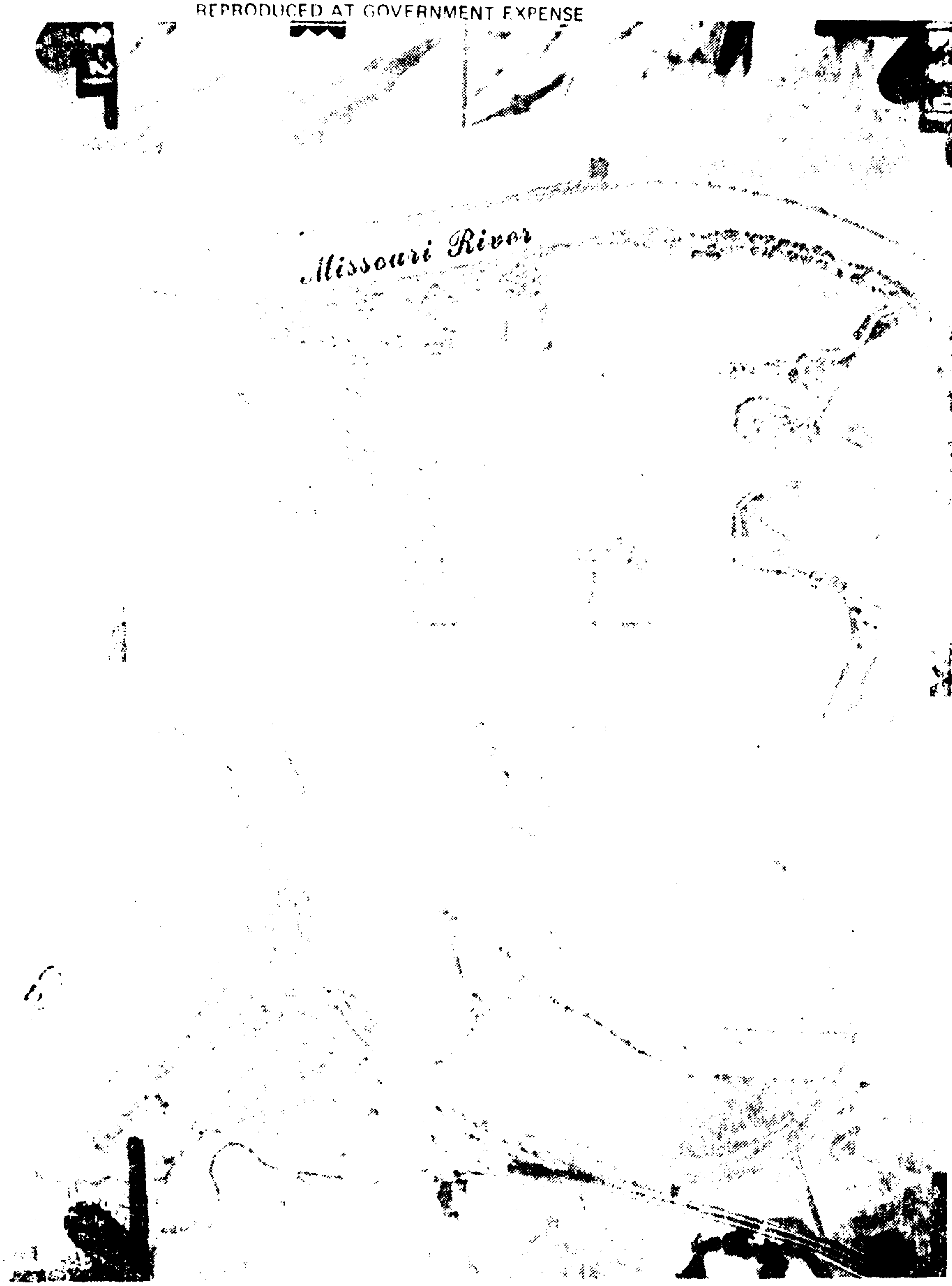
SPRING FLOOD 1984

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

PLATE 87


Indian
Creek
M-30


BELLEVUE
Offutt

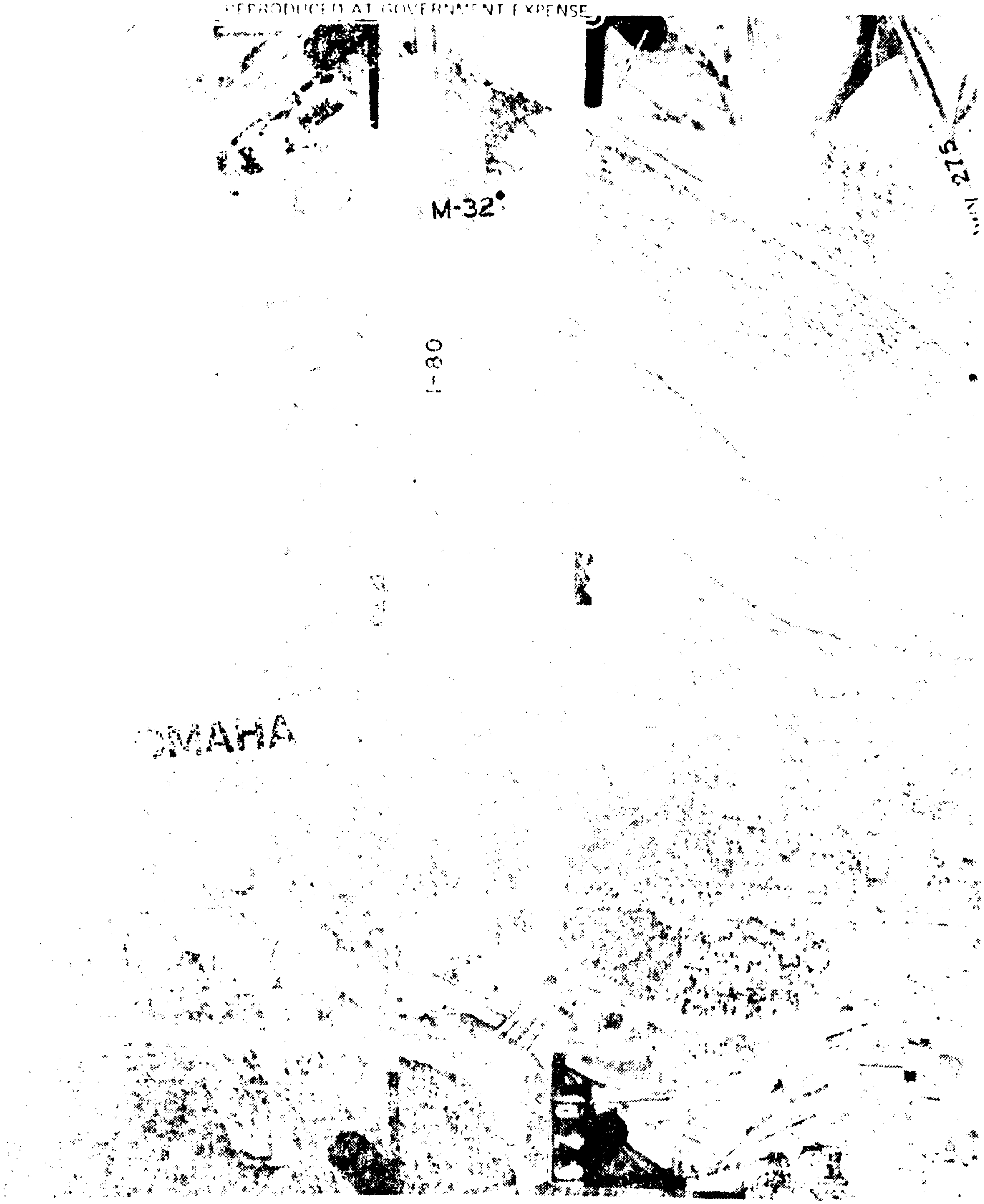


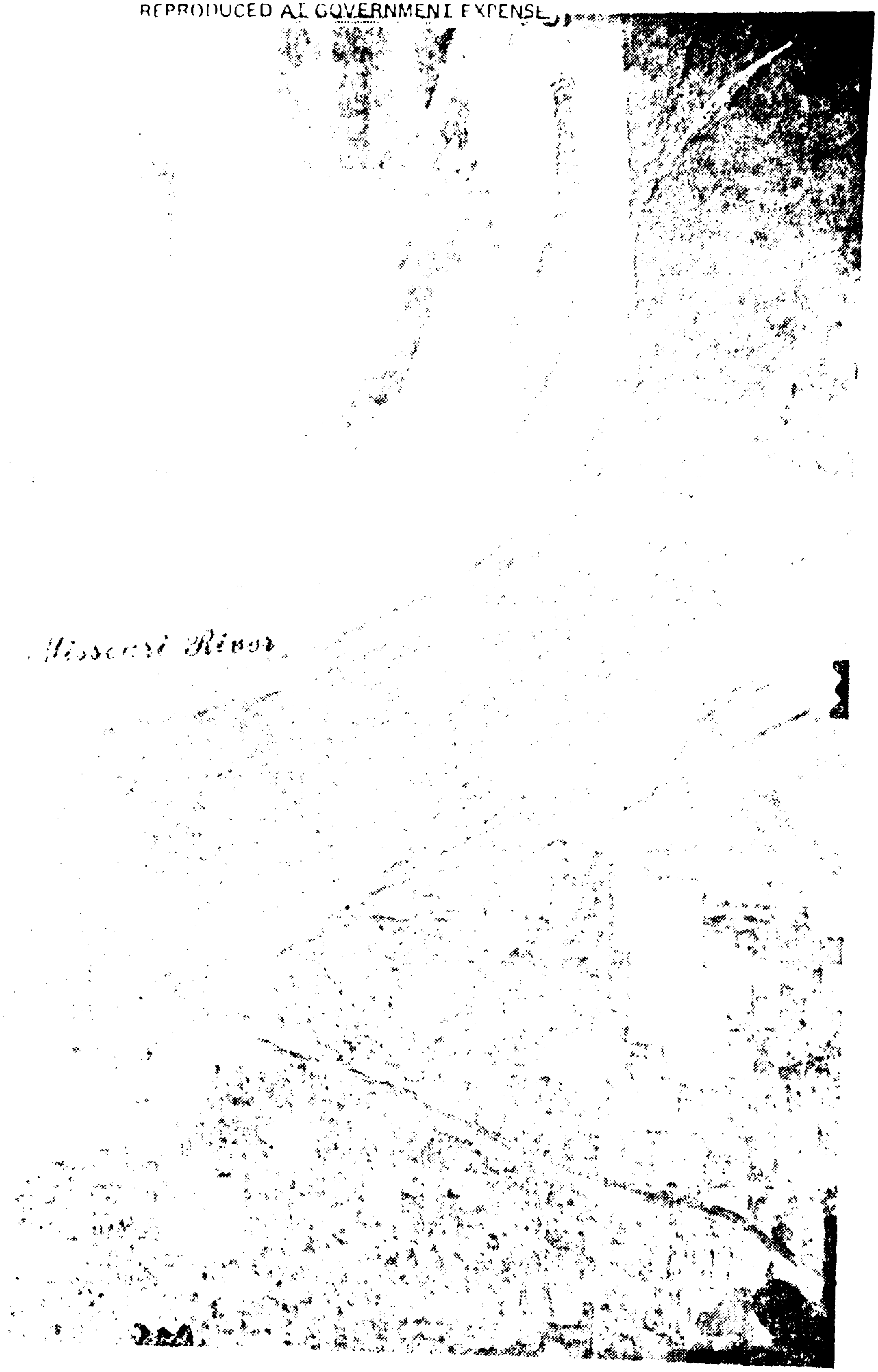
MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984


COUNCIL BLUFFS
N
I-480


M-32
I-80
OMAHA
275



MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

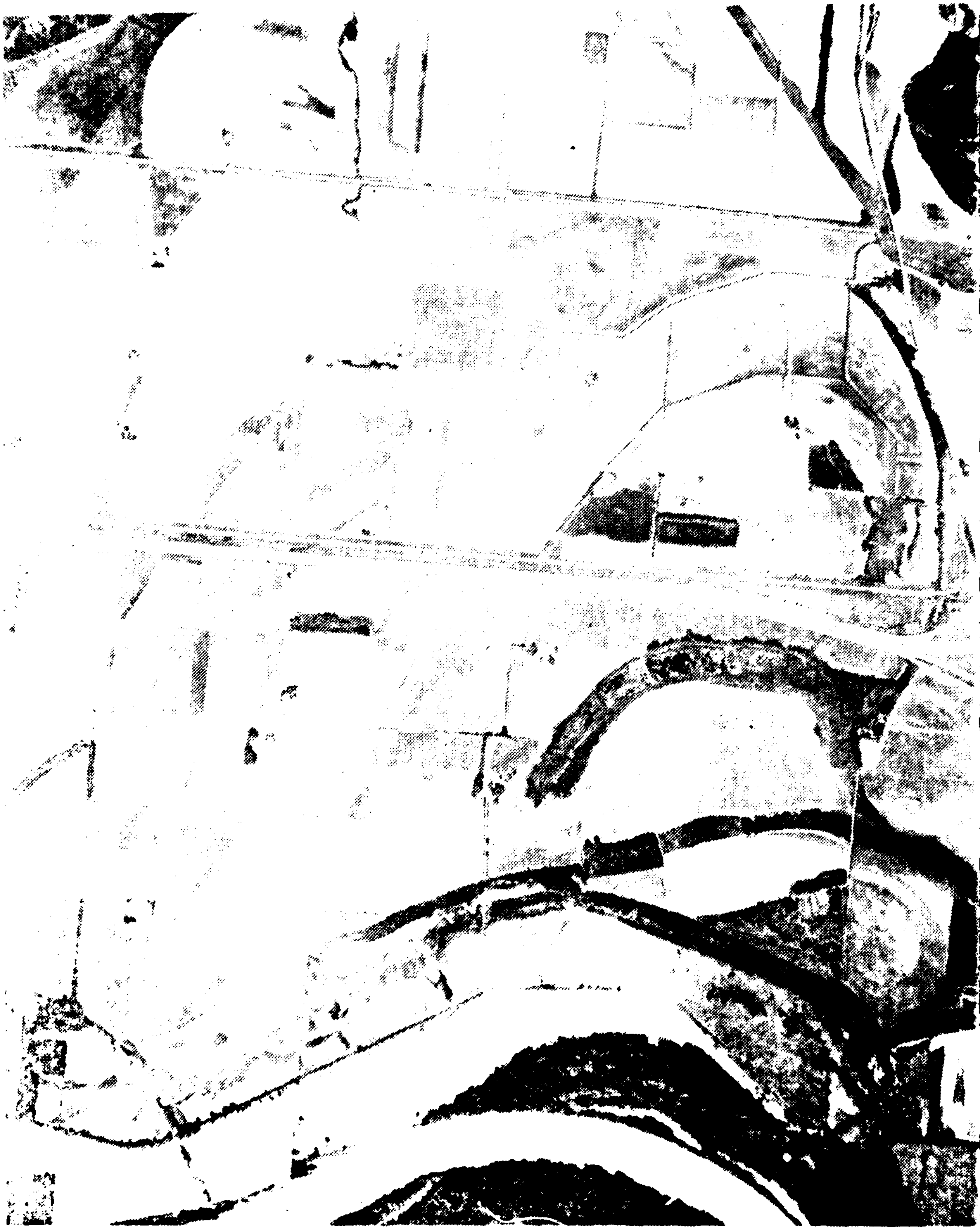

I-680

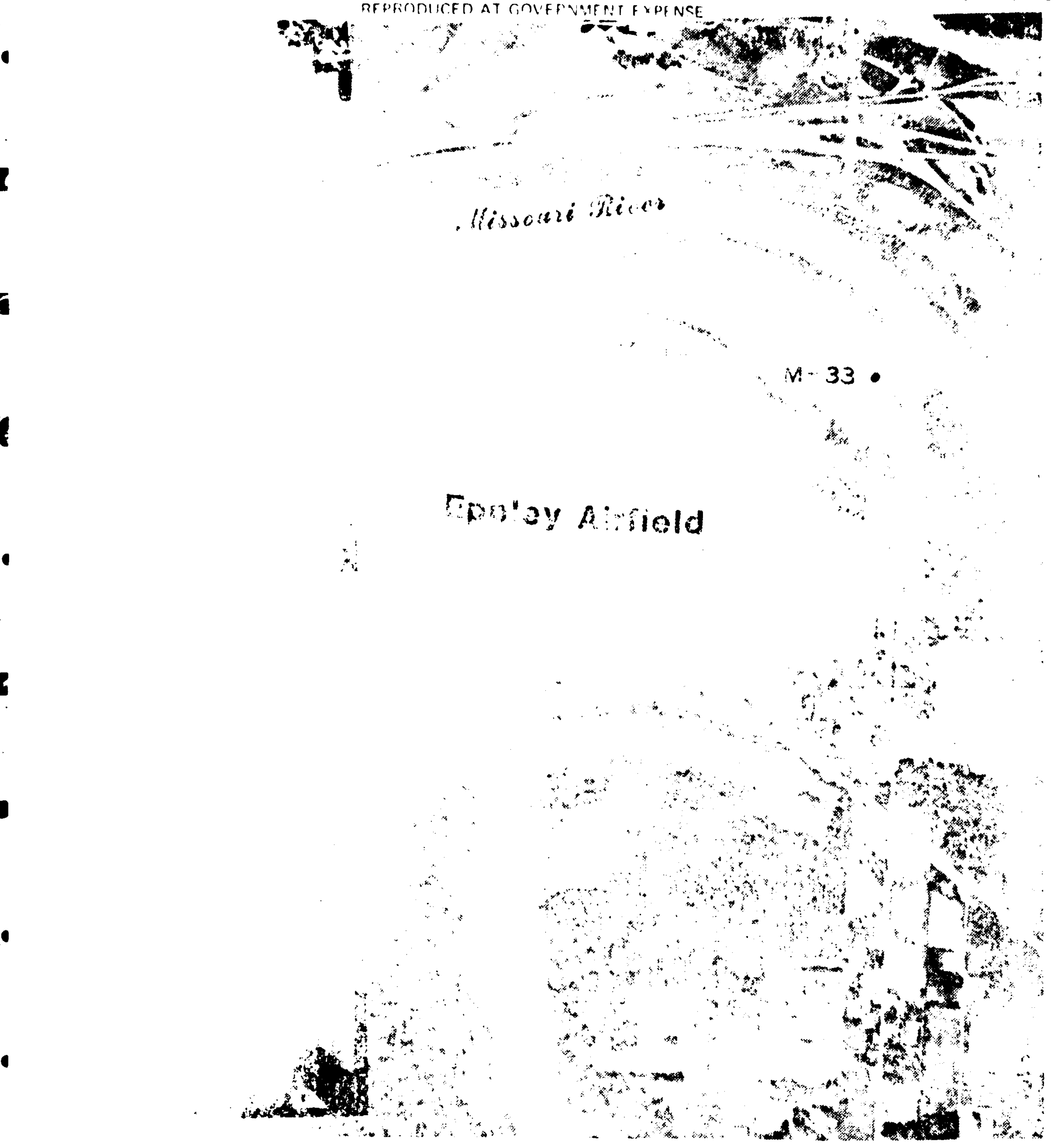

Missouri River
M-34
626
NORTH OMAHA

MISSOURI RIVER AND TRIBUTARIES

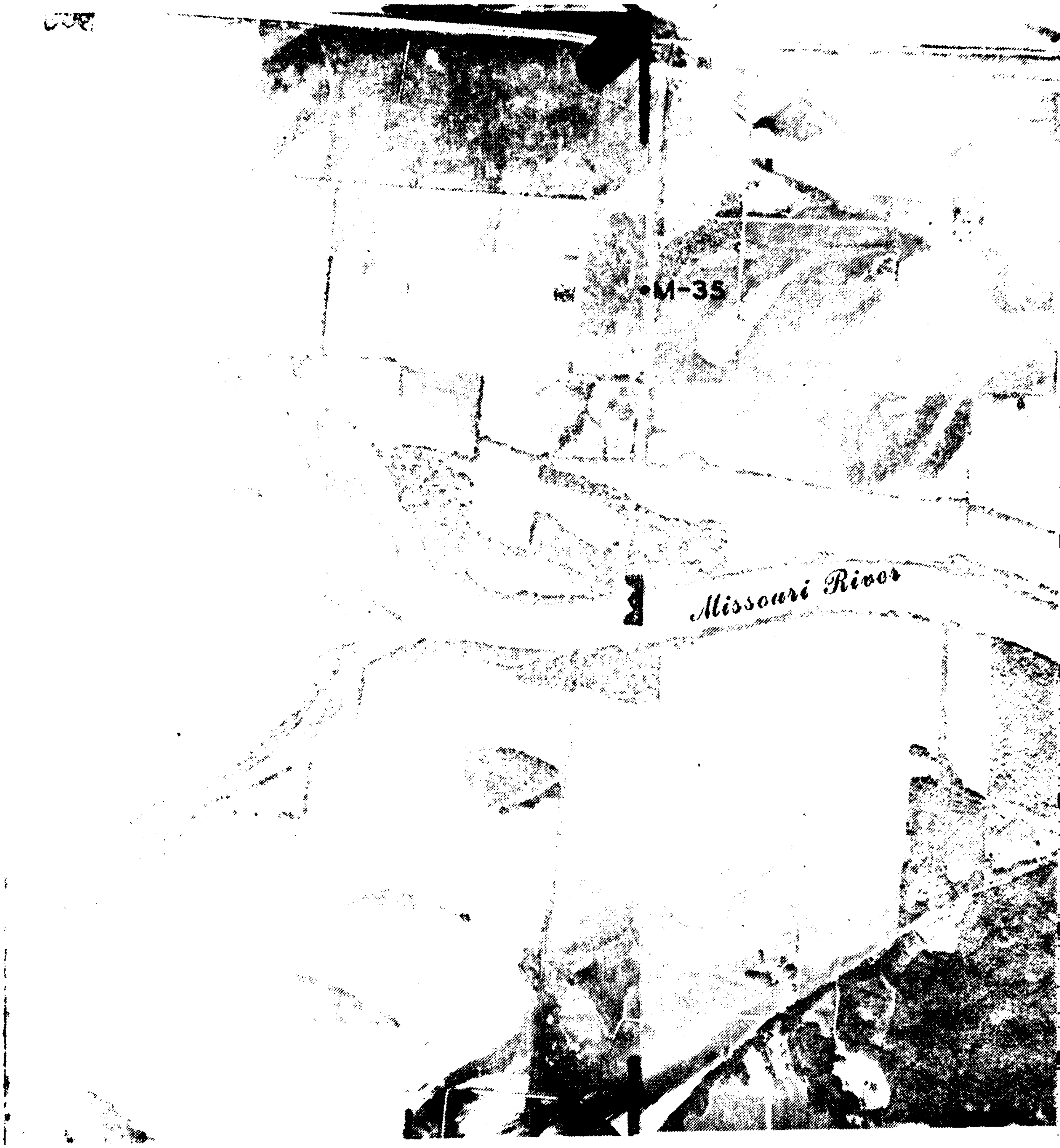
SPRING FLOOD 1984

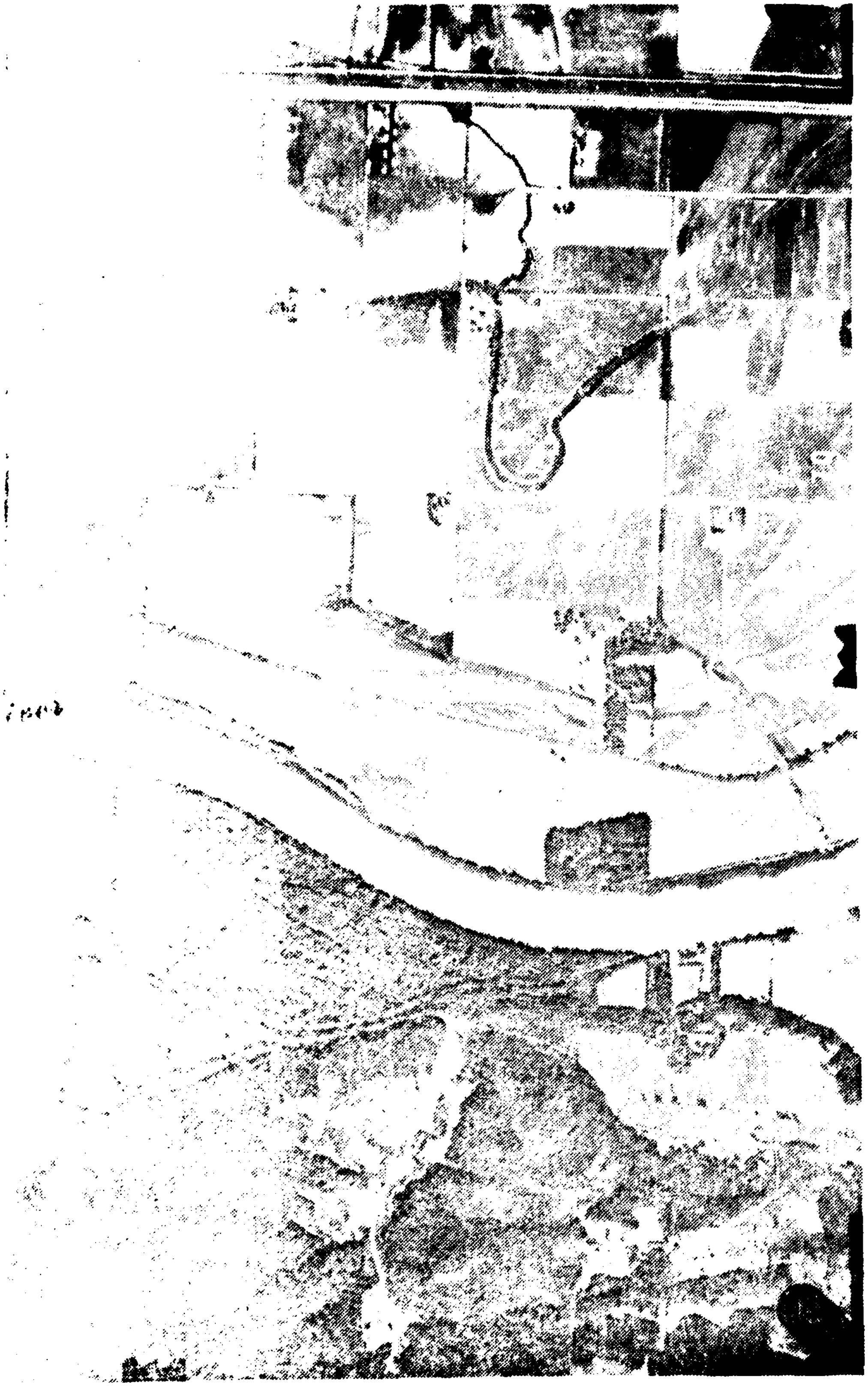
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984





MISSOURI RIVER AND TRIBUTARIES
SPRING FLOOD 1984
U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984


M-35
Missouri River

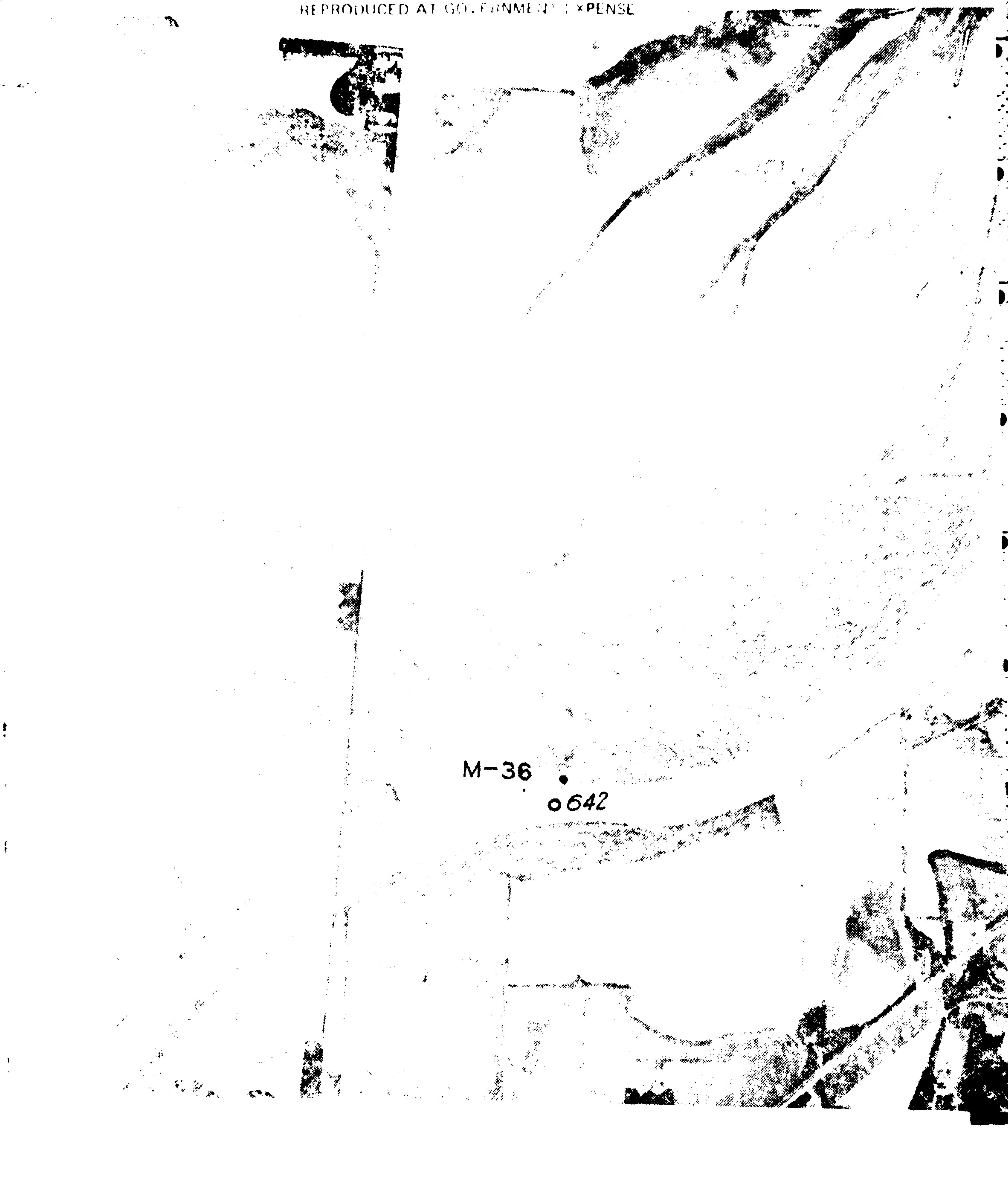


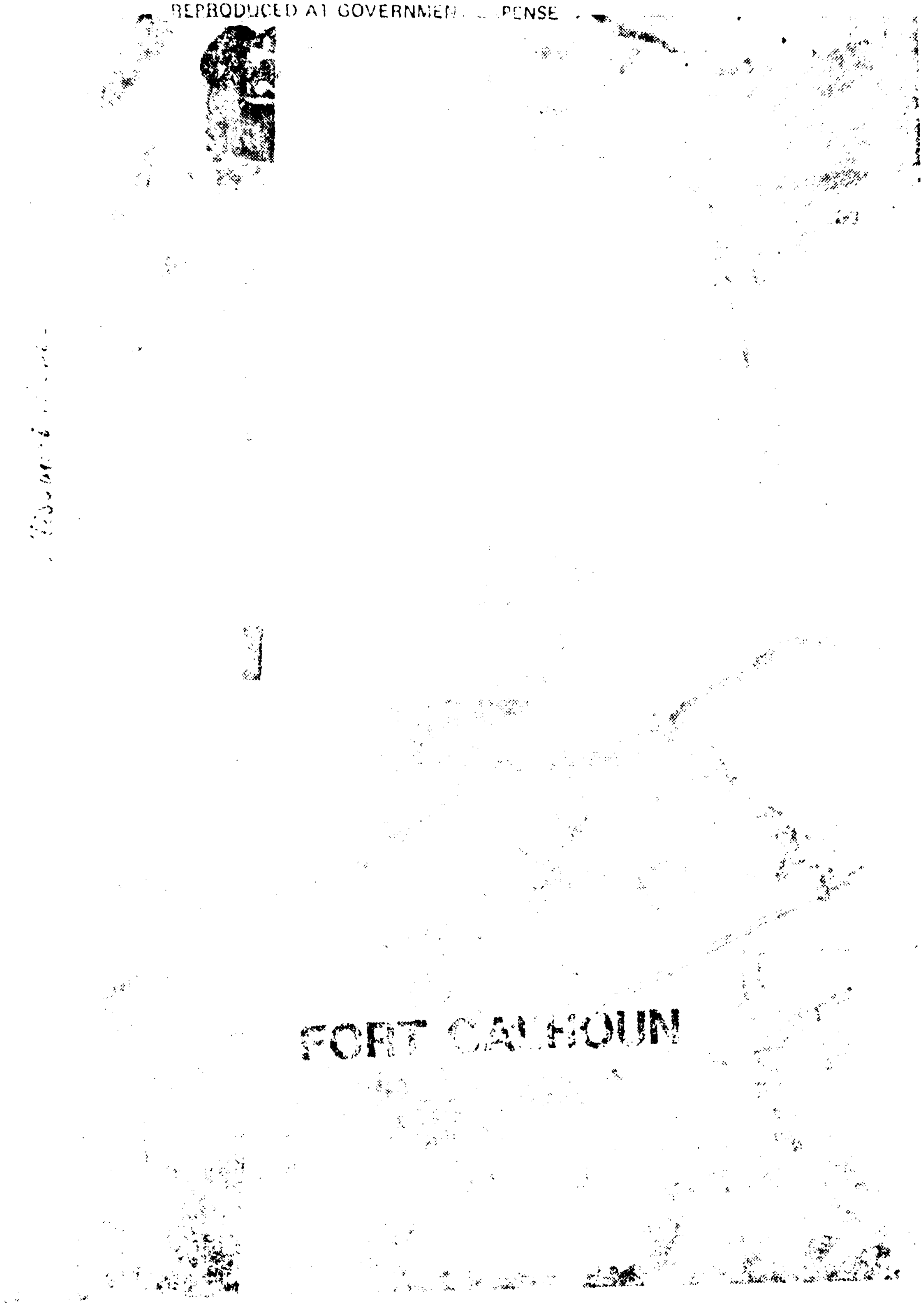
MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984


N
De Soto Lake


M-36
642



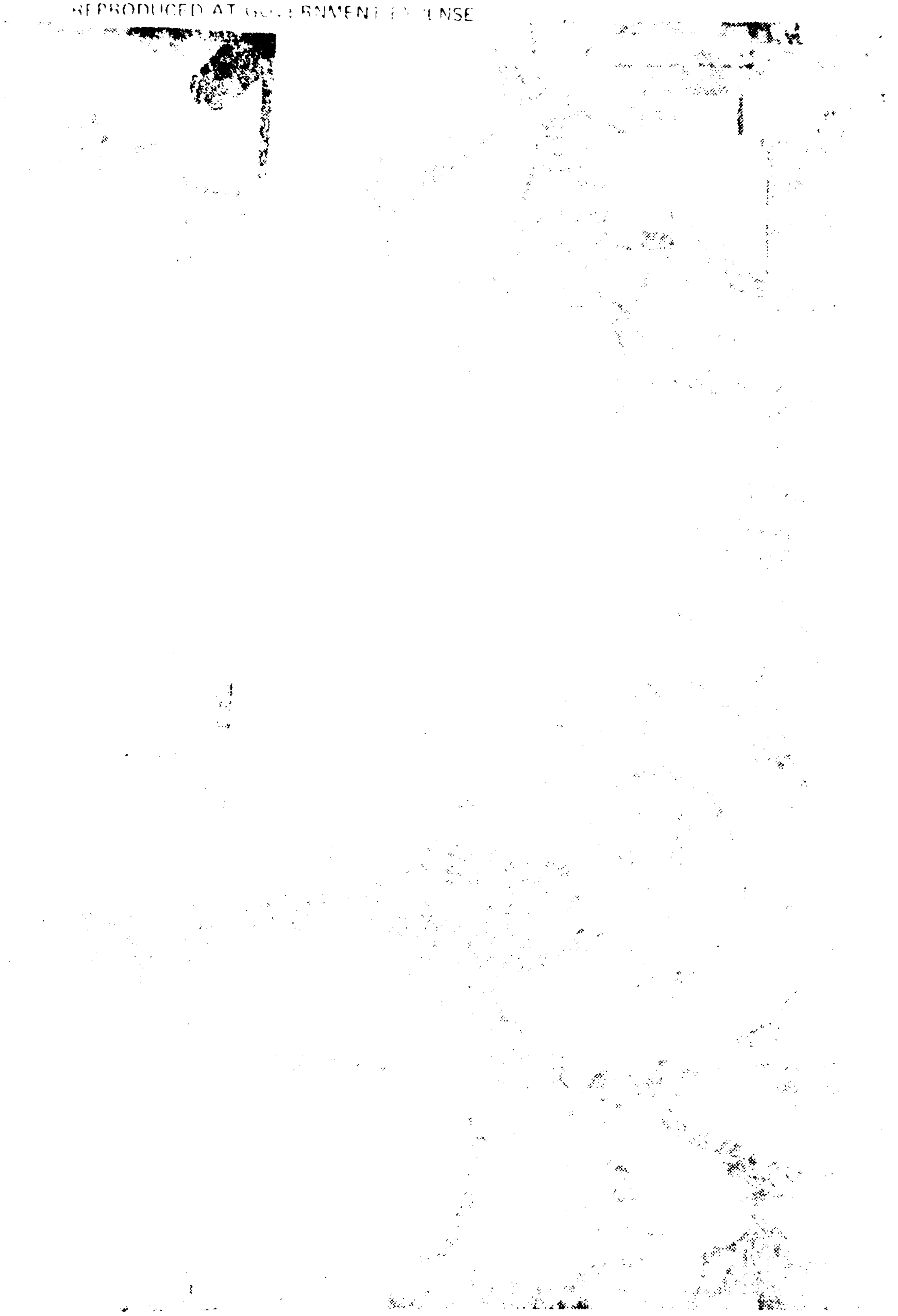
MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

PLATE


Missouri River



MISSOURI RIVER AND TRIBUTAR

SPRING FLOOD 1984

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

PLATE

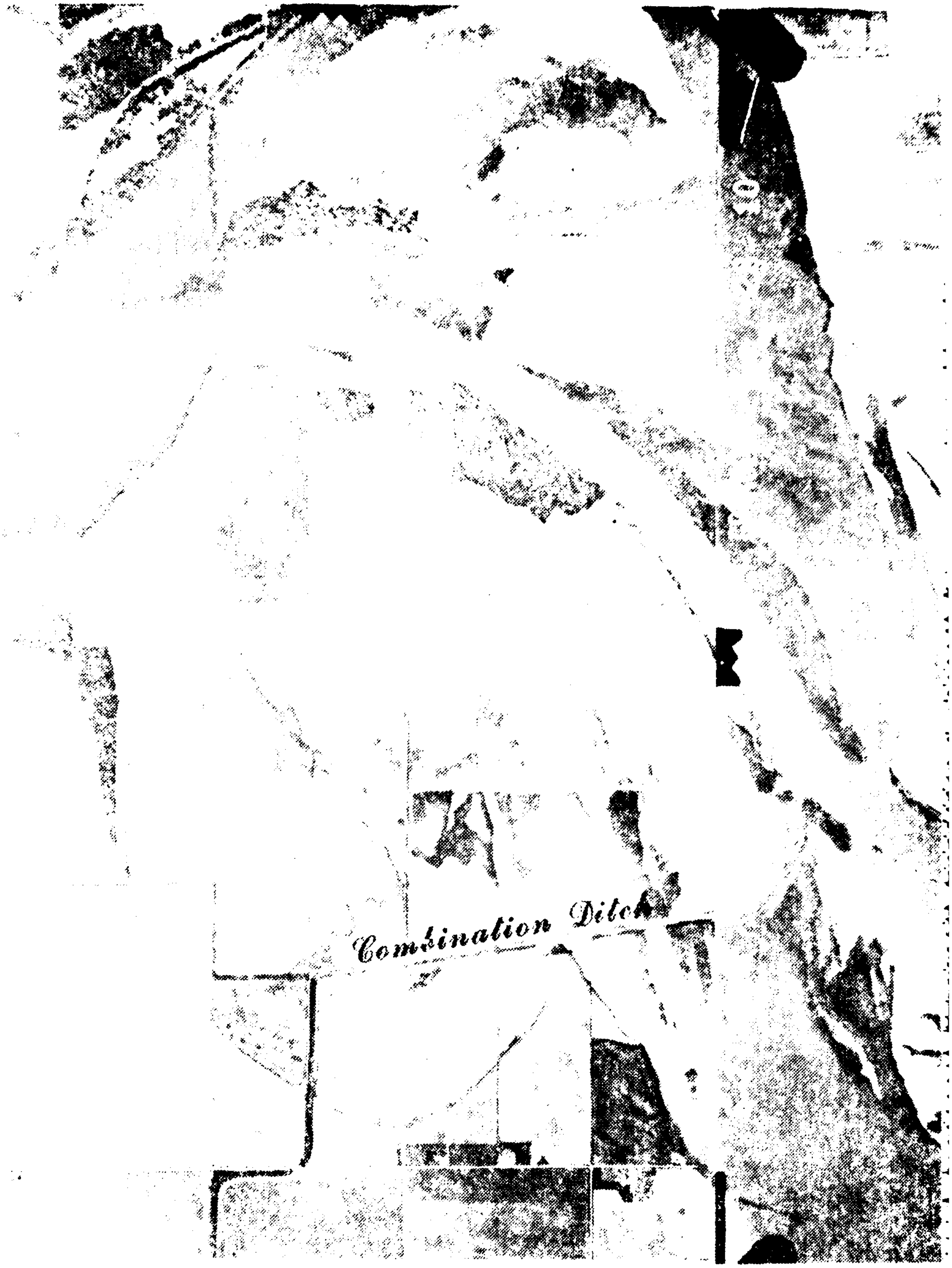

Hwy 30
648 o
M-36a
Cameron Ditch
BL

MISSOURI RIVER AND TRIBUTARIES

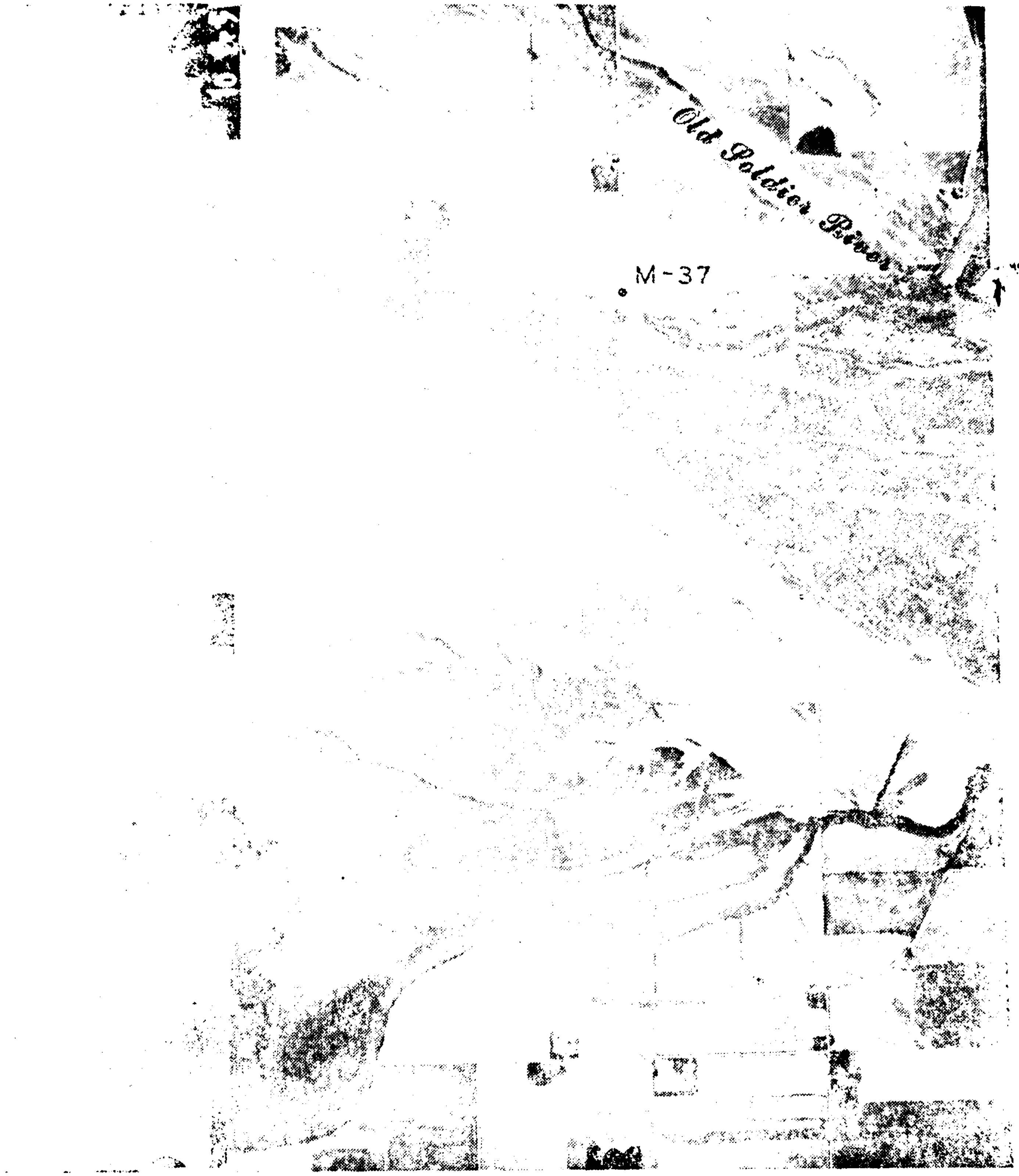
SPRING FLOOD 1984

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

PLATE 9


Combination Ditch


M-38
Missouri River



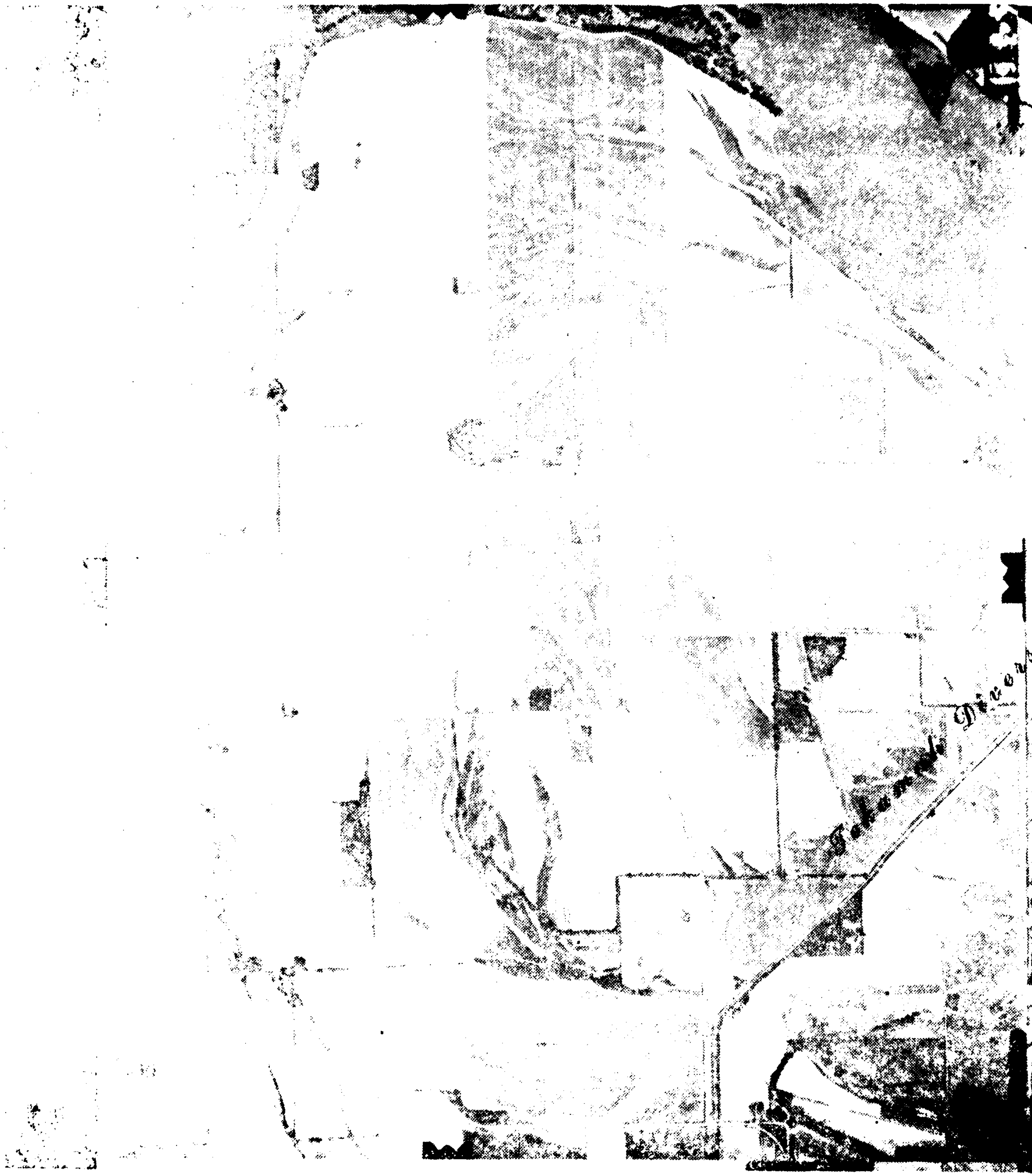
MISSOURI RIVER AND TRIBUTARIES

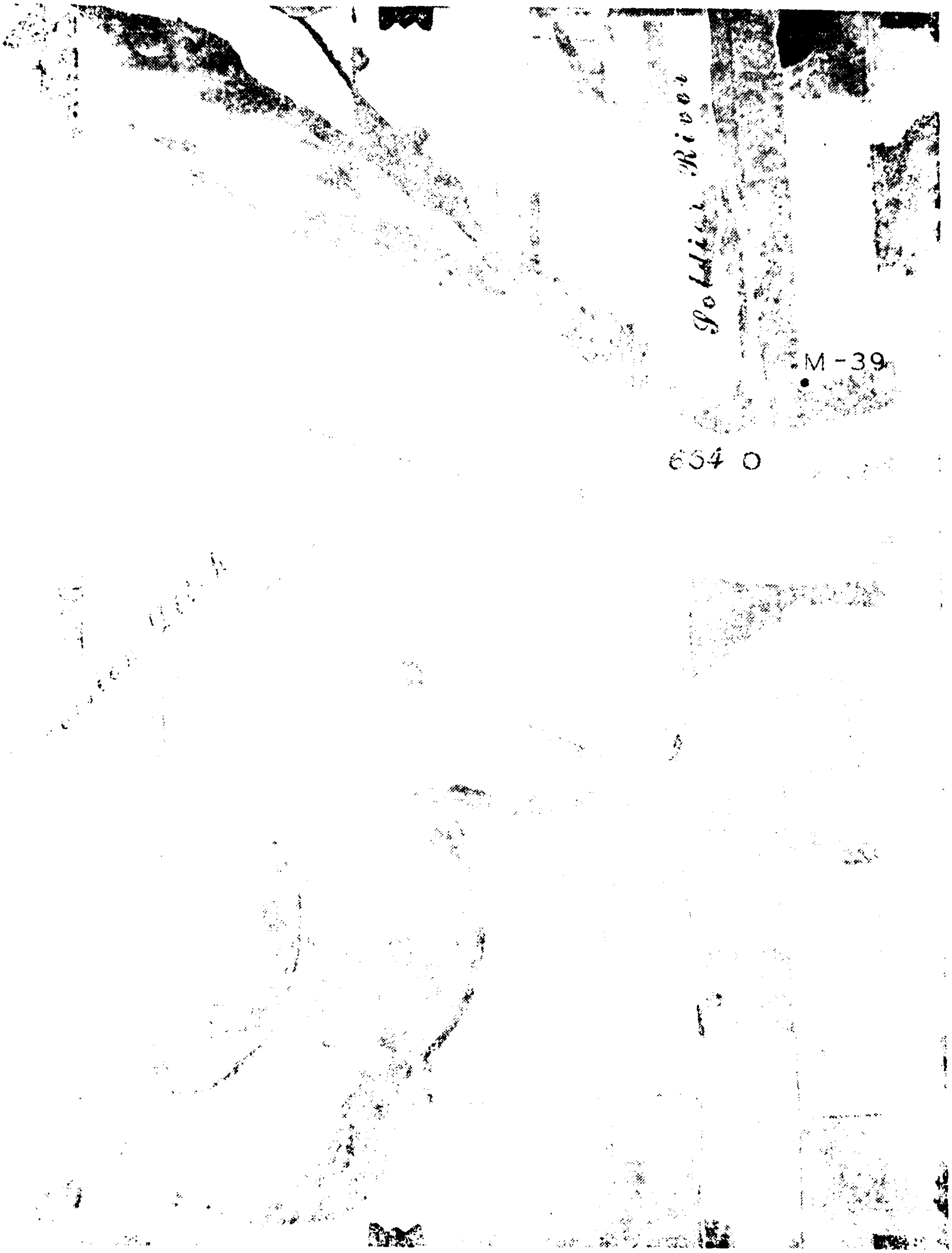
SPRING FLOOD 1984

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

PLATE 95


Deer Island
Missouri River





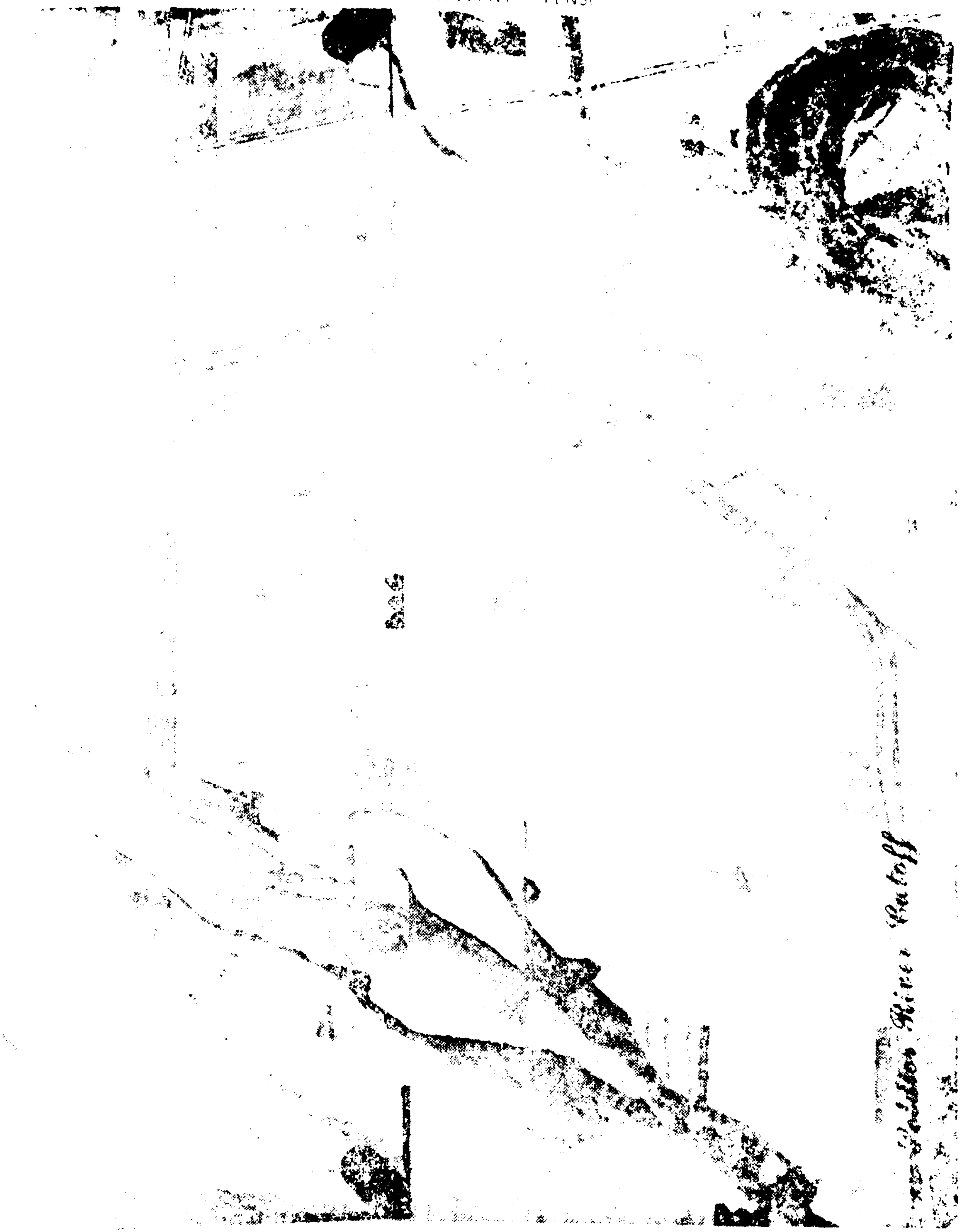
MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

PLATE

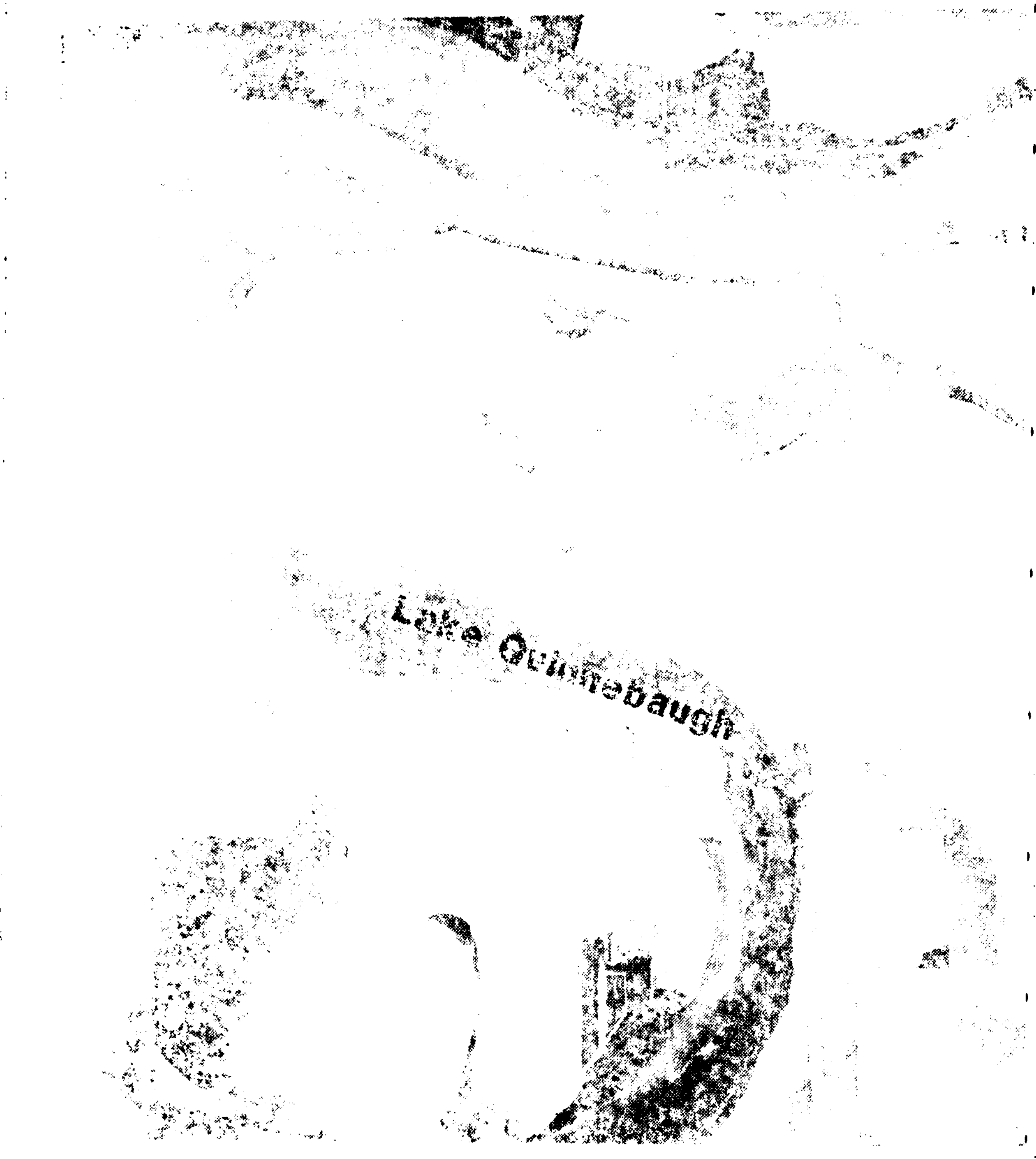

RIVER SIOUX



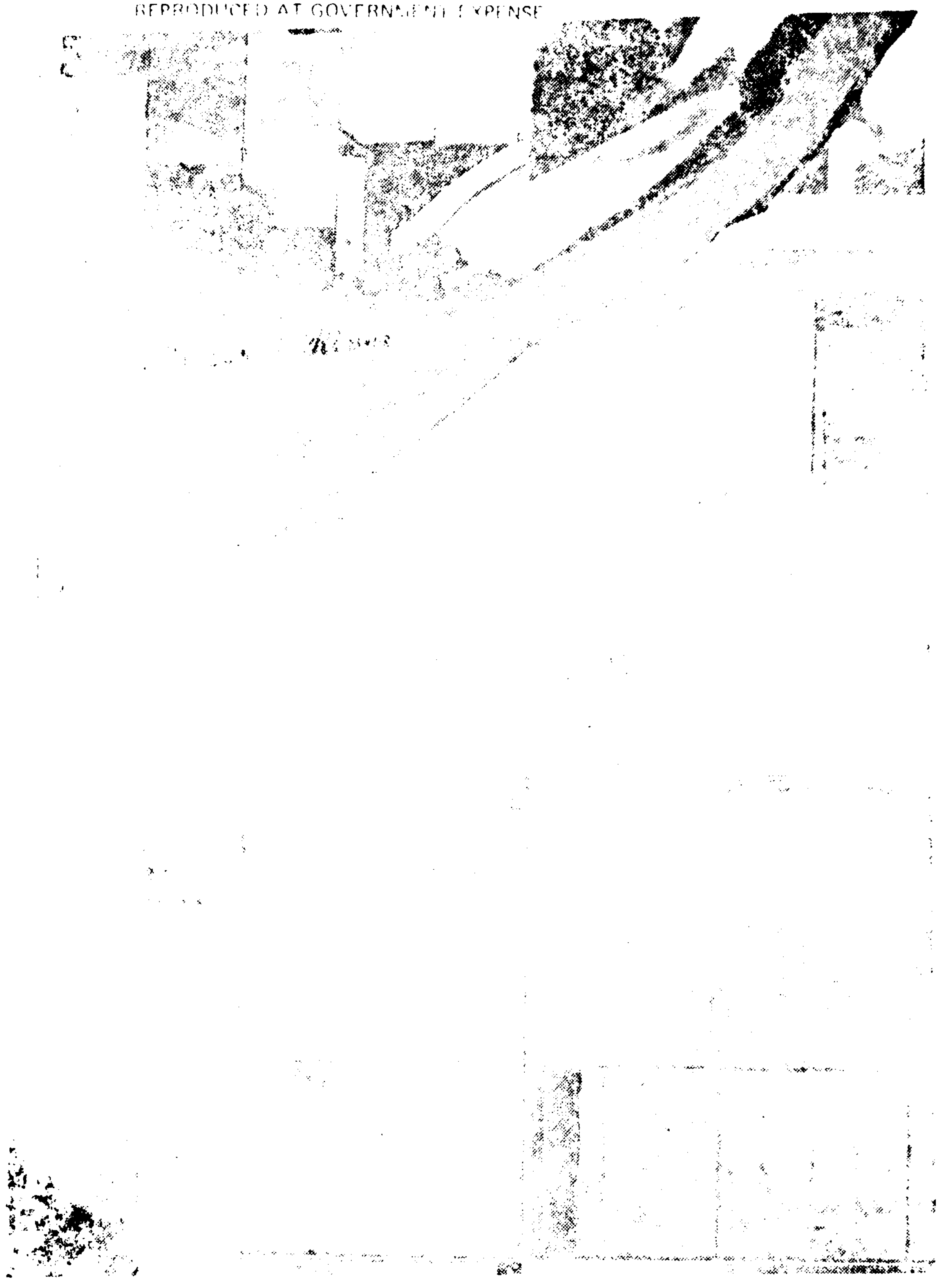
MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984


Lake Quinebaugh

M-40

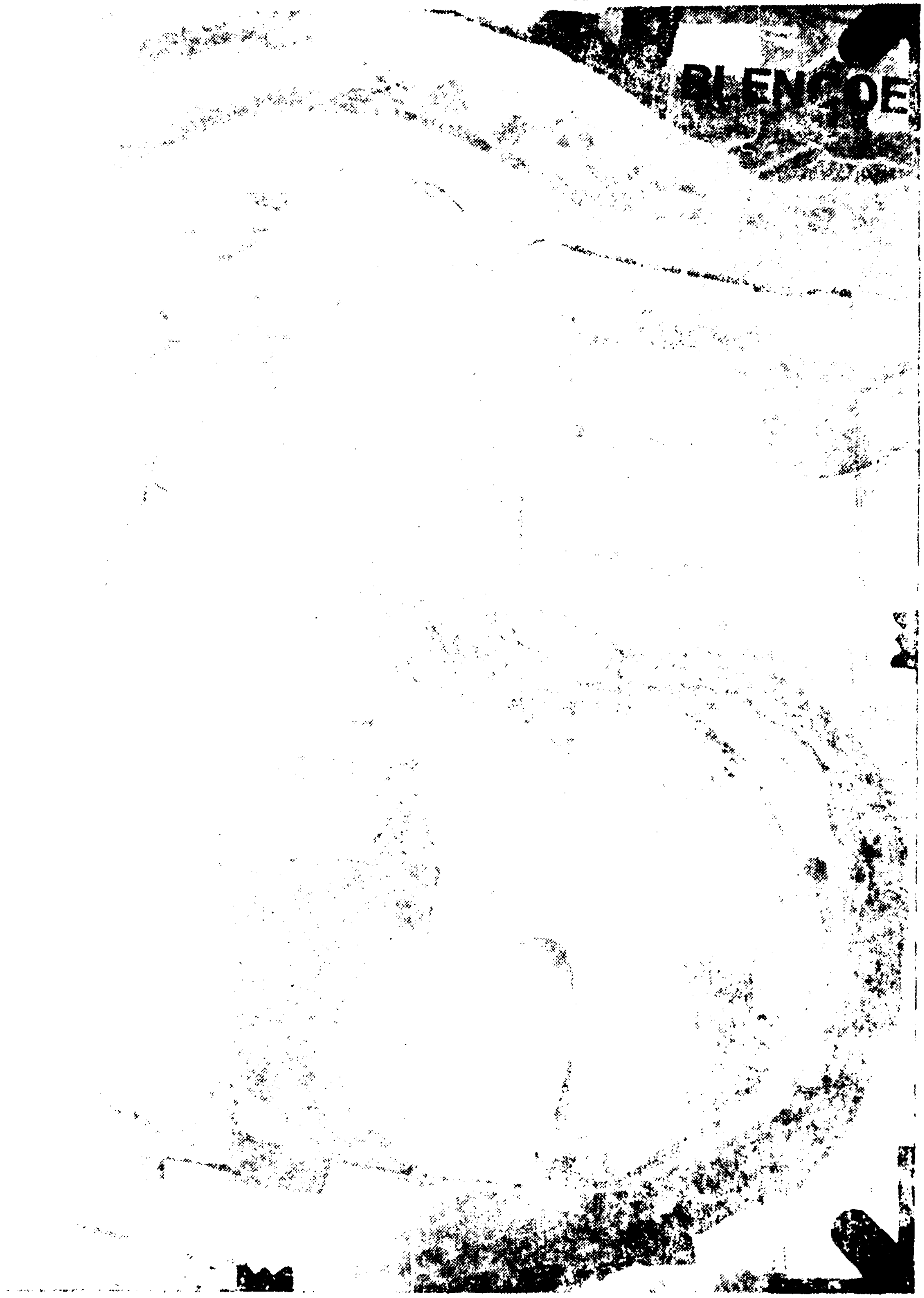


MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

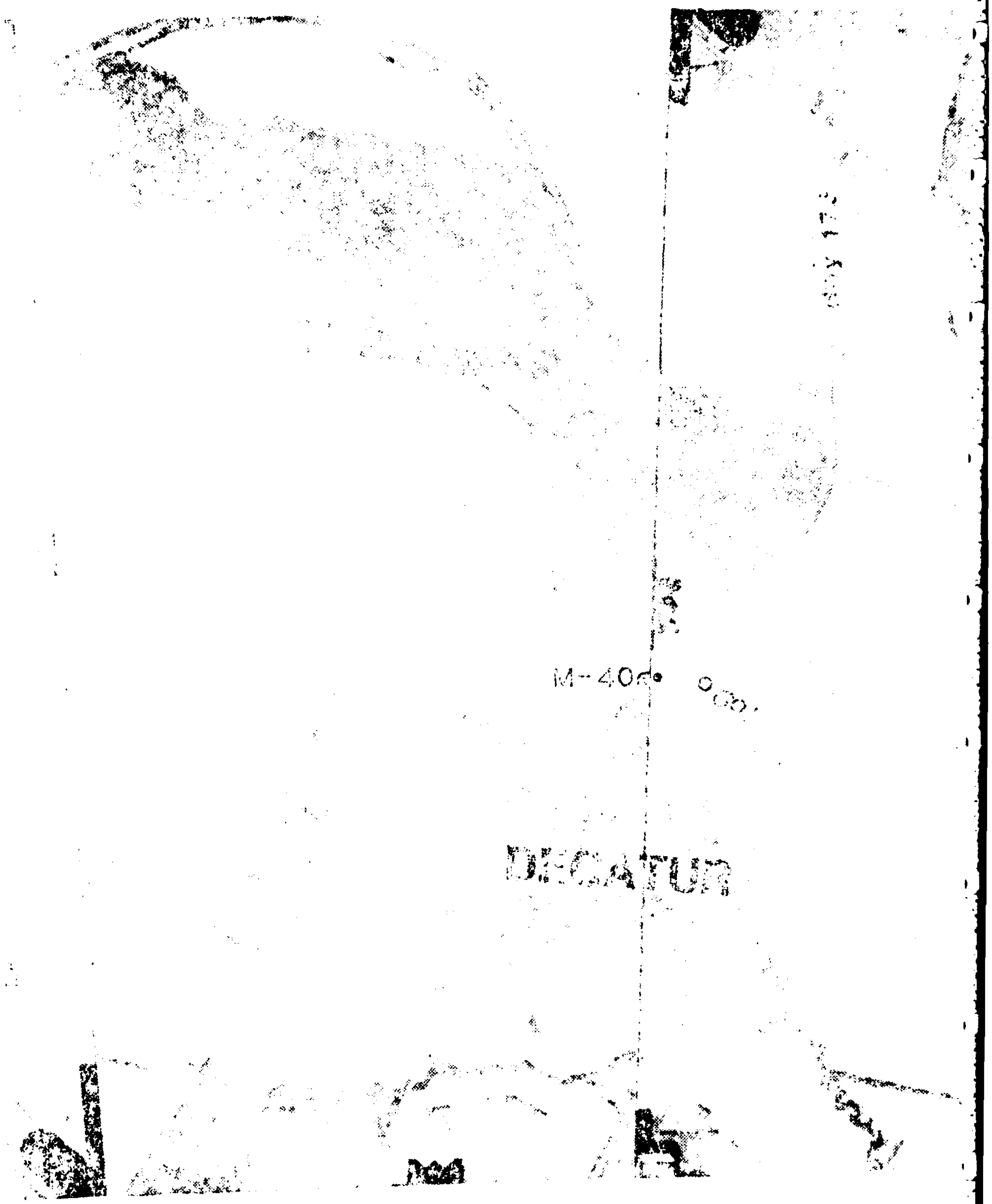

Missouri River



MISSOURI RIVER AND TRIBUTARIES
SPRING FLOOD 1984
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

PLATE


N
Missouri River


M-40
DECATUR

MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT 1984

PLATE 101


M-42


Blackbird Creek
Missour

MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT 1984

PLATE


Missouri River
Sand-Hill Lake Ditch

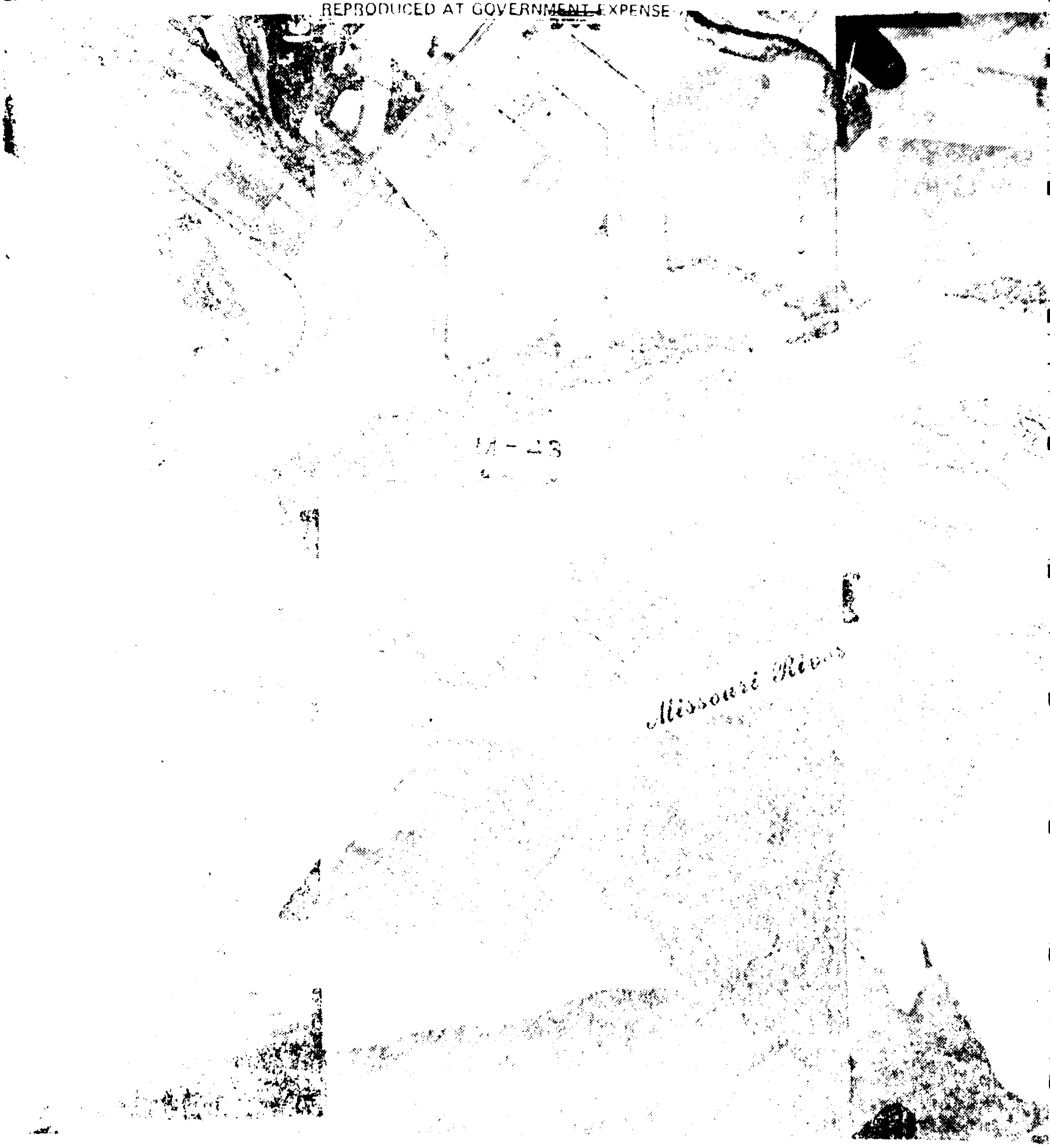
MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT 1984

PLATE

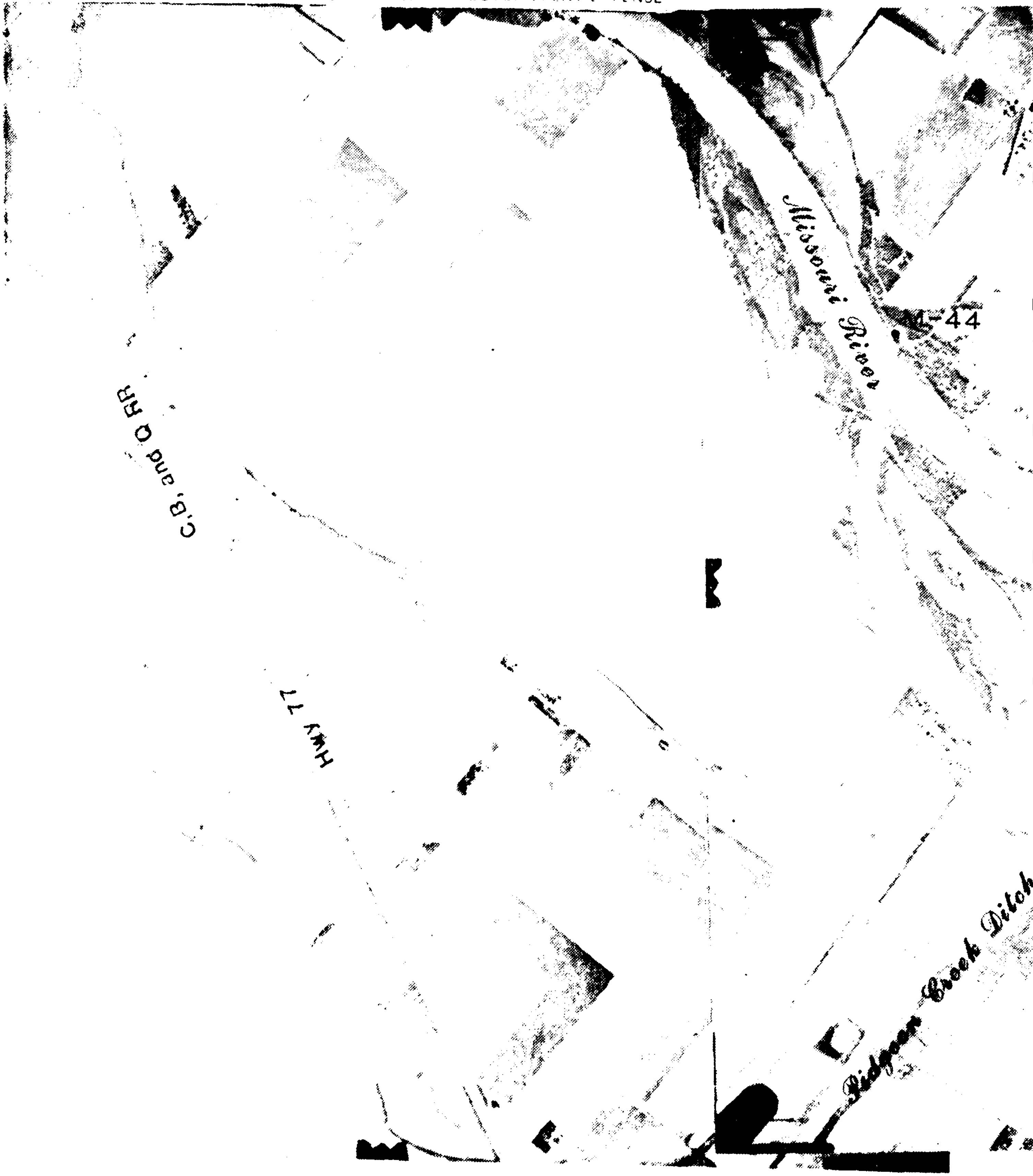

Omaha Creek Ditch


Missouri Riv

MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT 1984

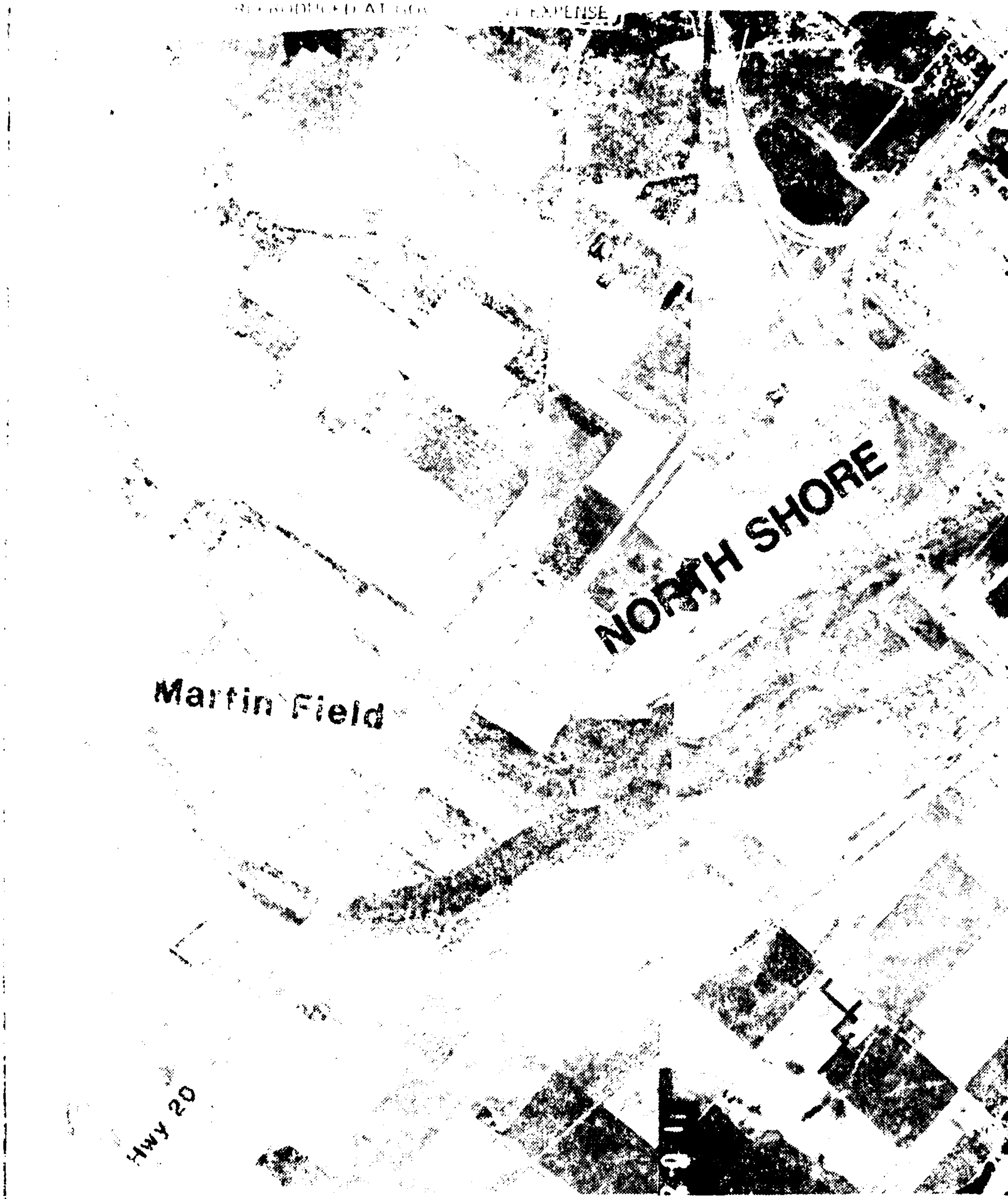

M-44
Missouri River
C.B. and Q RR
Hwy 77
Pidgeon Creek Ditch

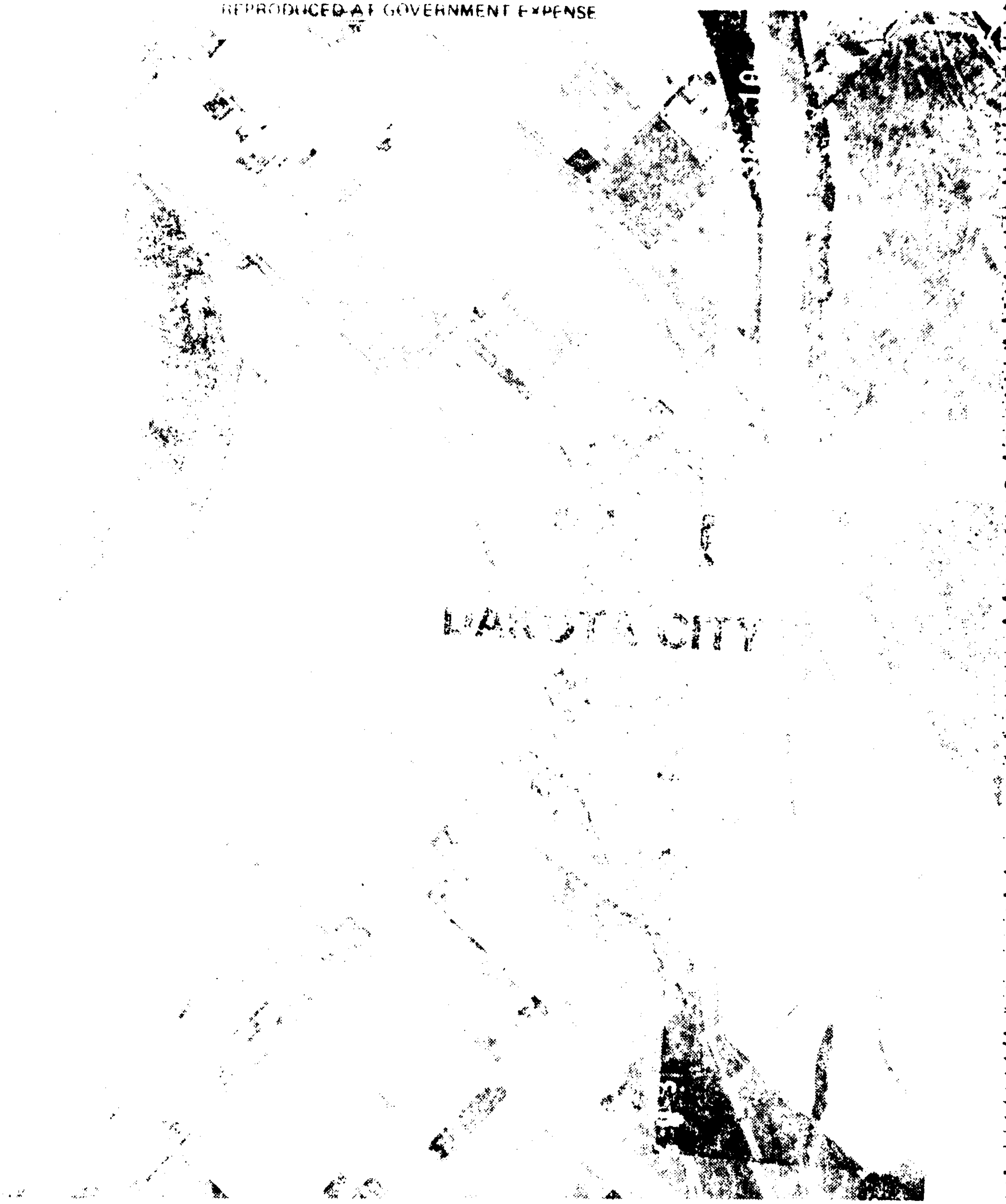
MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

PLATE 105

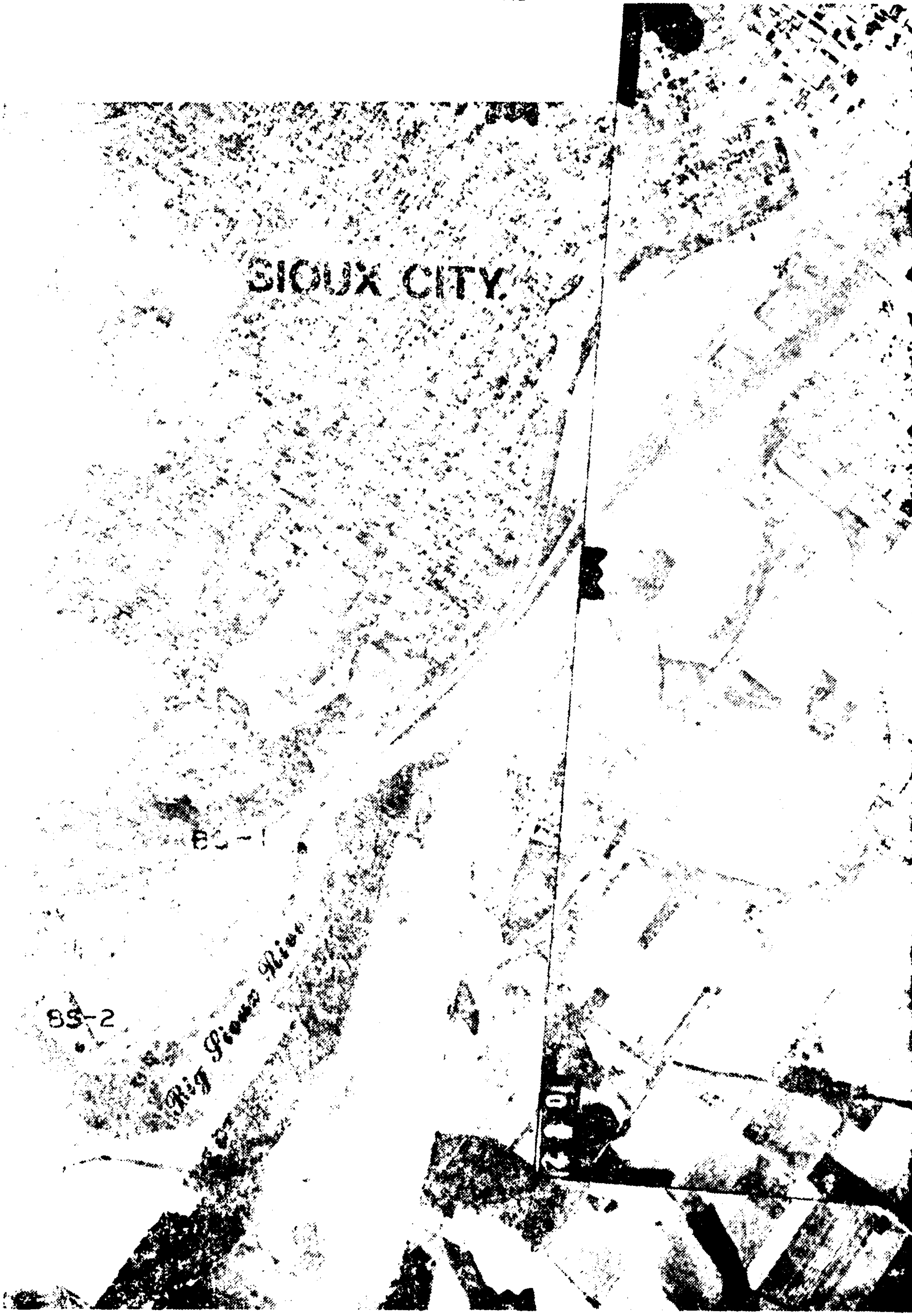

NORTH SHORE
Martin Field
Hwy 20

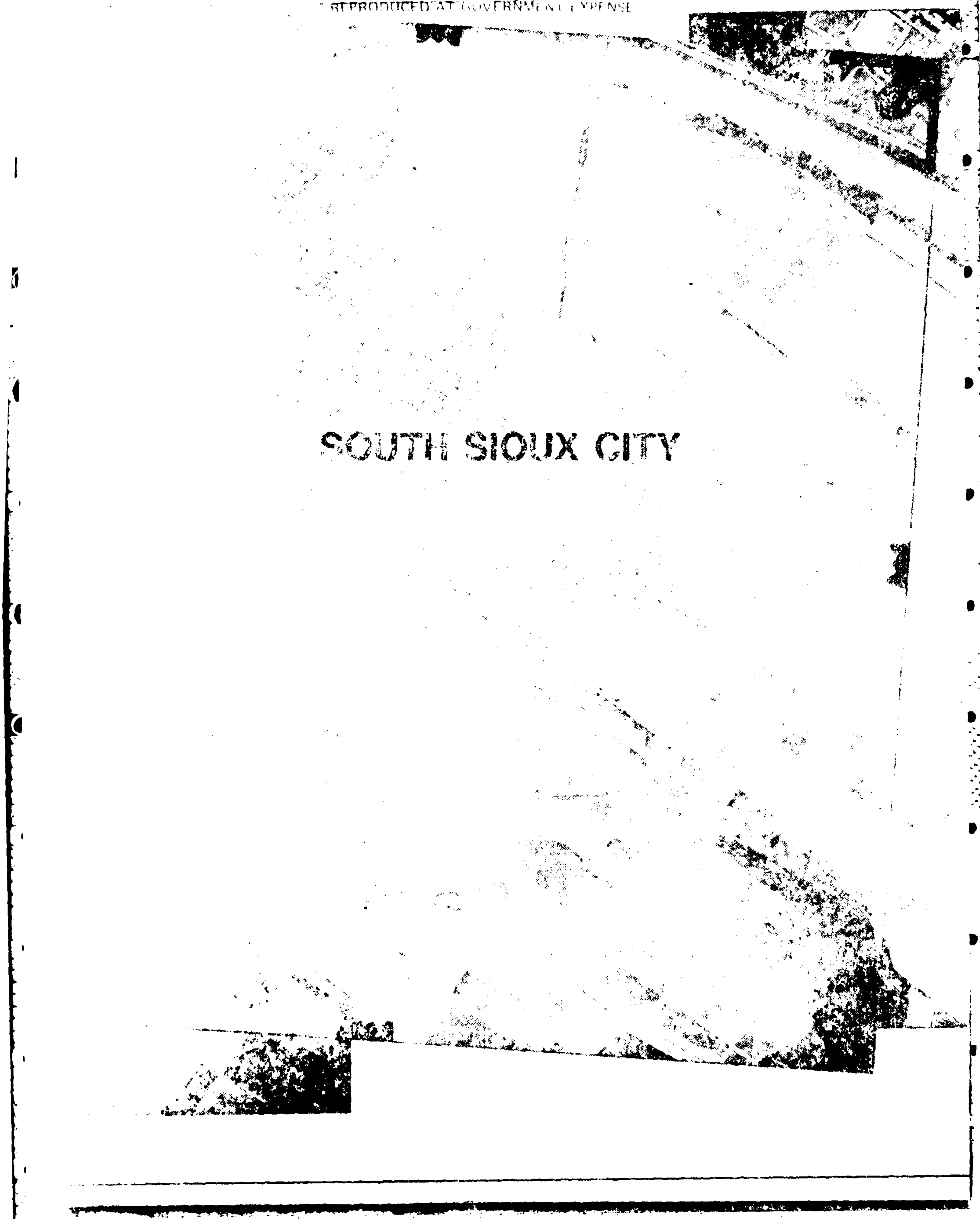


MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984


SIOUX CITY
BS-1
BS-2
Big Sioux River

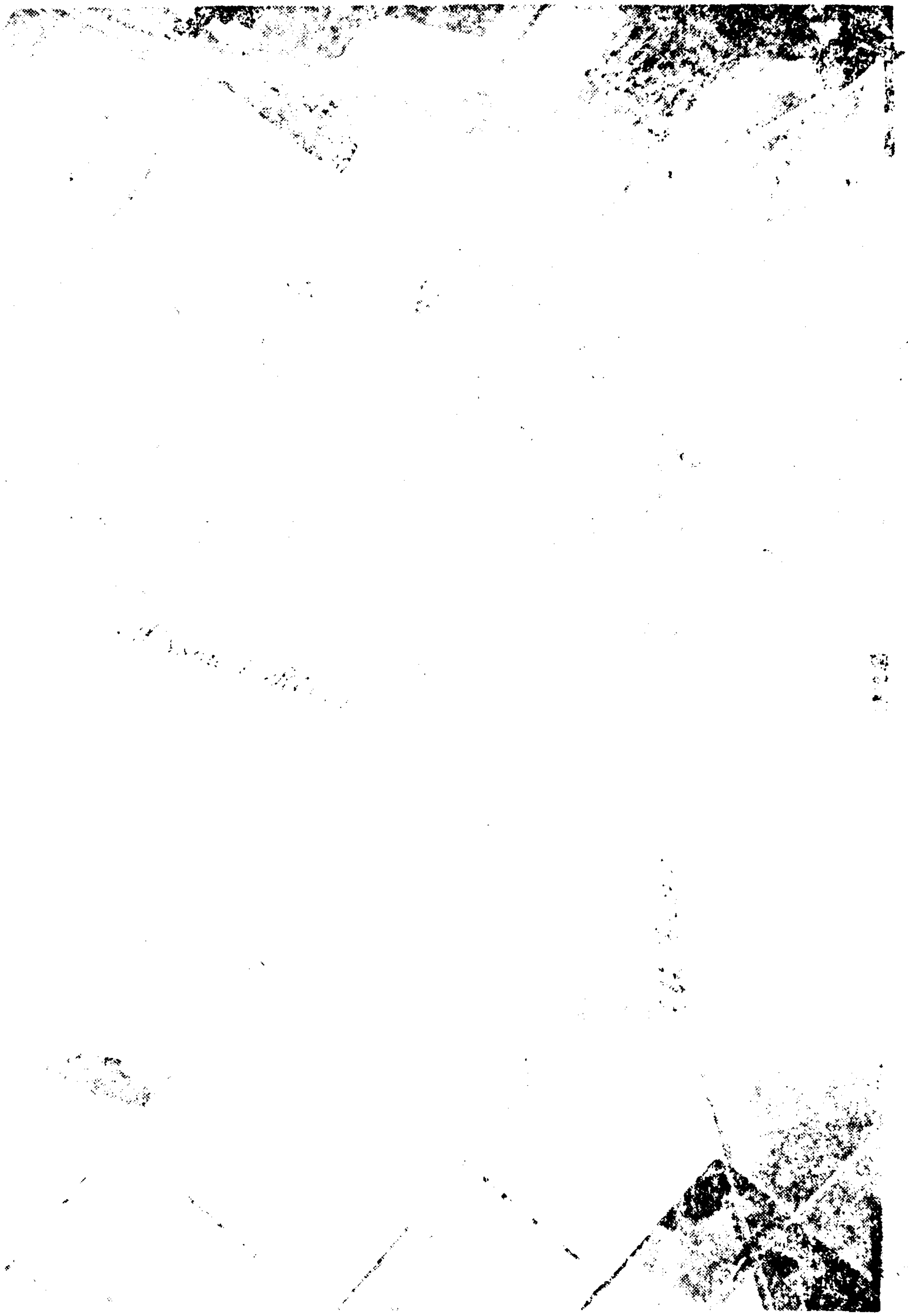

SOUTH SIOUX CITY

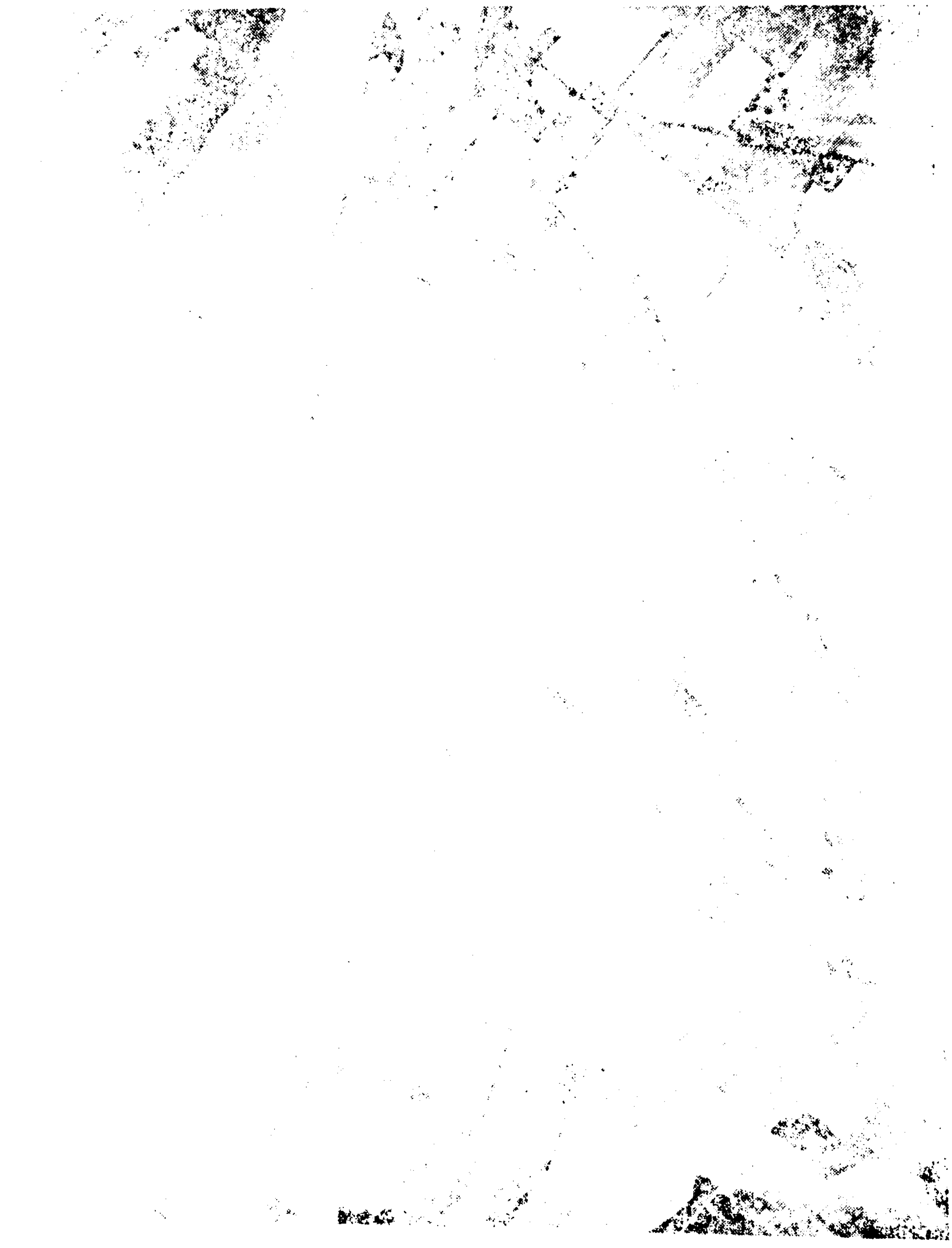
MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

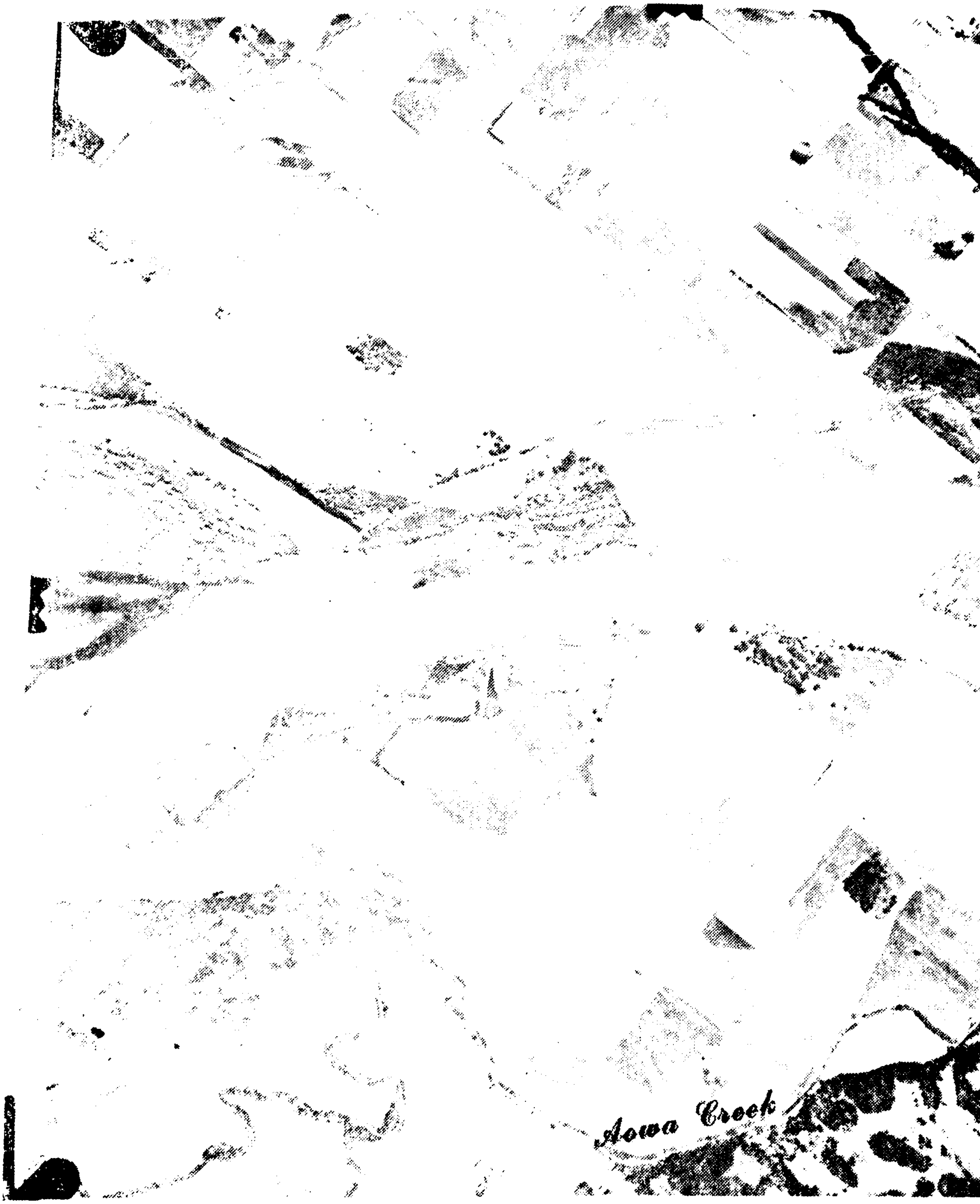
PLATE



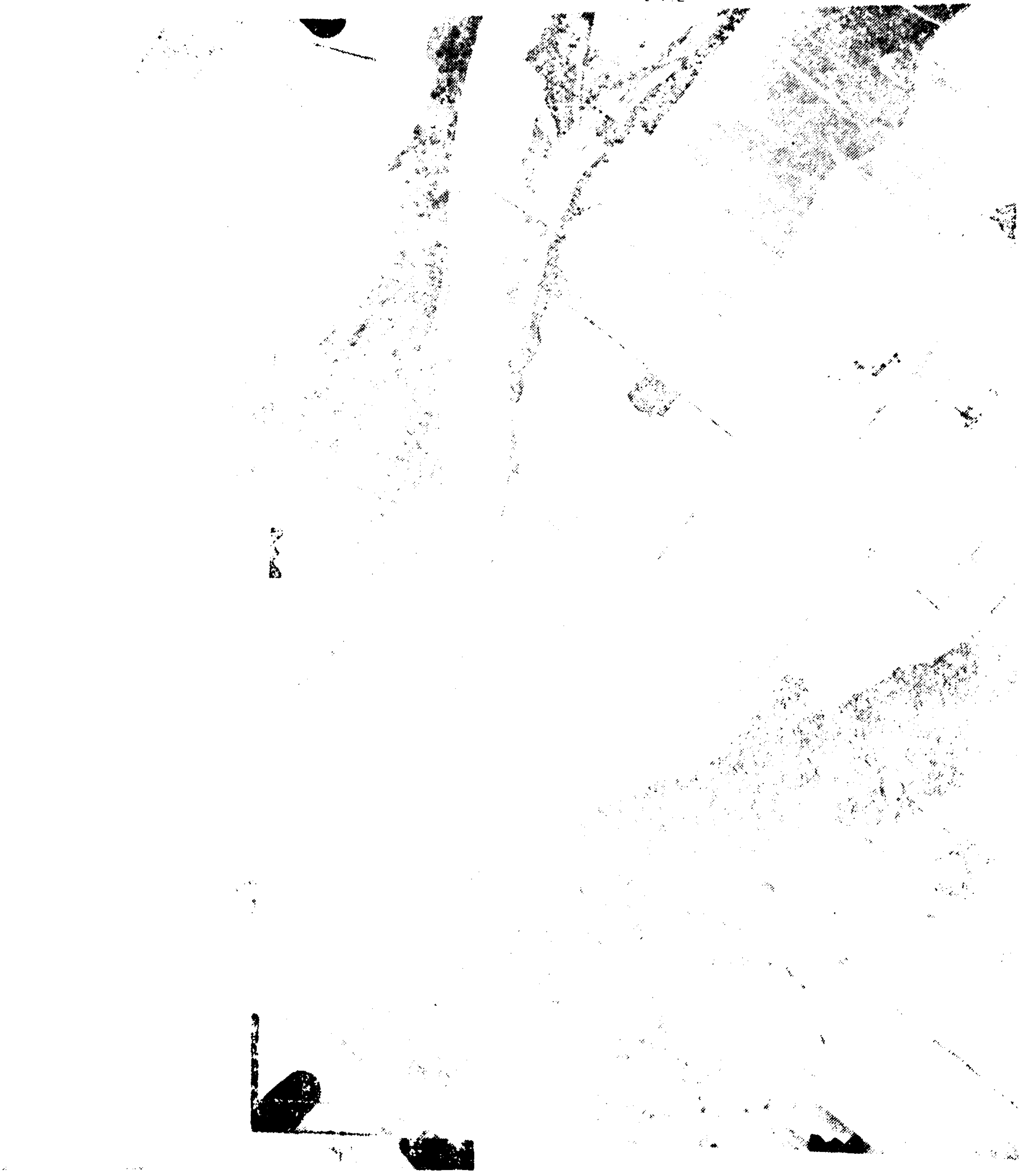


MISSOURI RIVER AND TRIBUTARIES
SPRING FLOOD 1984

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT 1984


Aowa Creek


Missouri River

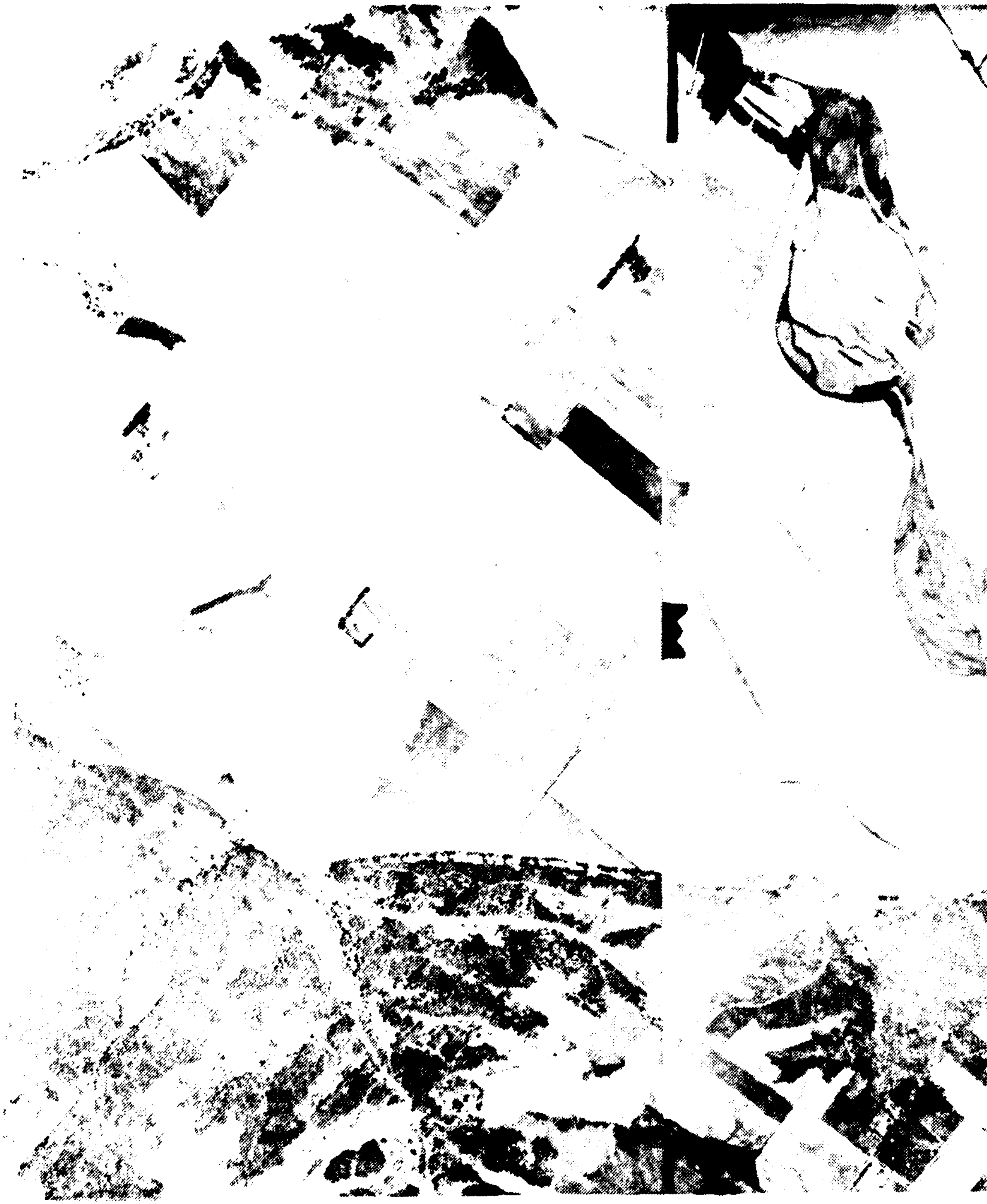


MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

PLATE [illegible]



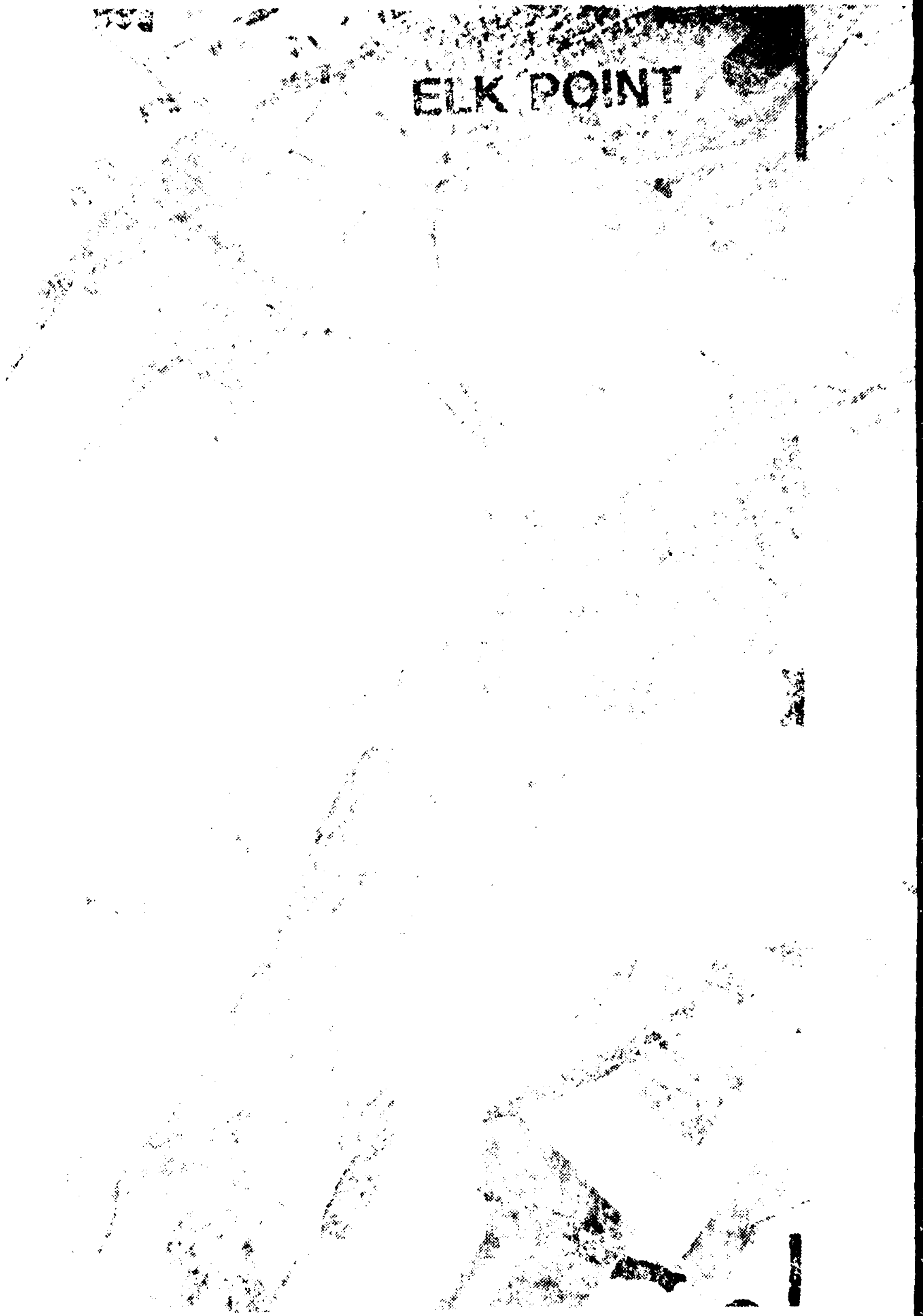

Missouri River

MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

PLATE [illegible]

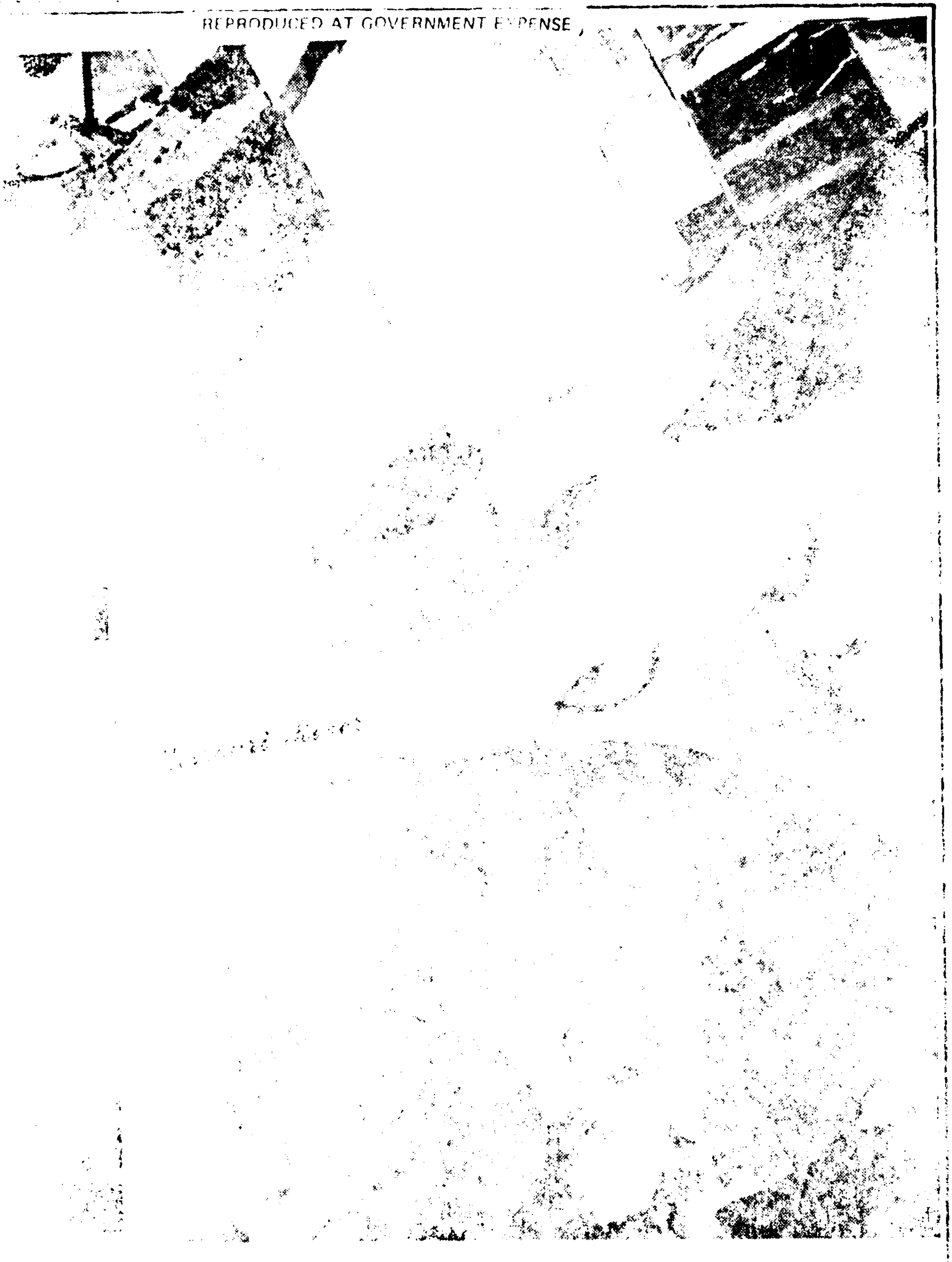

ELK POINT

MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

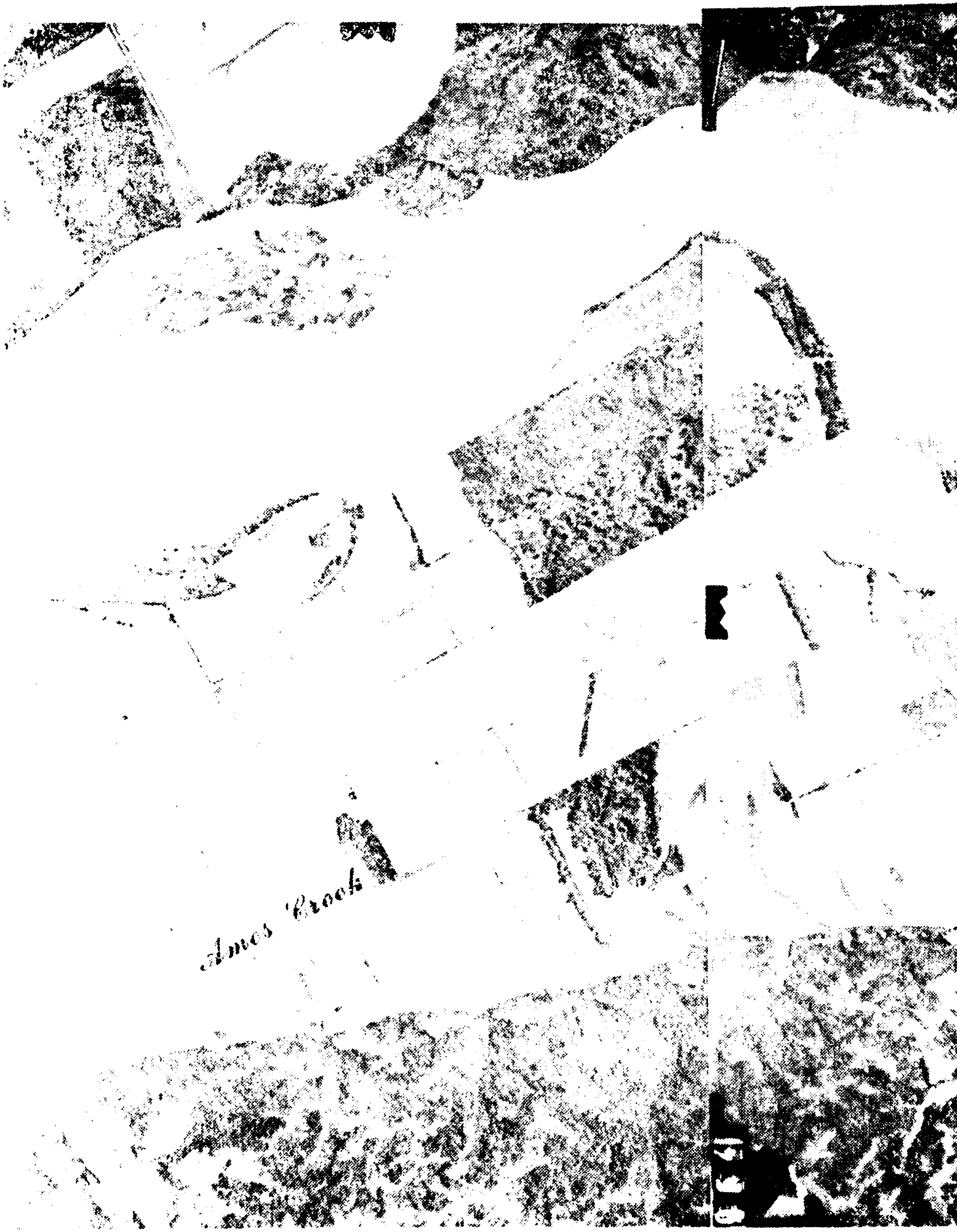
PLATE



MISSOURI RIVER AND TRIBUTARIES
SPRING FLOOD 1984

ARMY ENGINE[illegible]

[illegible]


Amos Creek

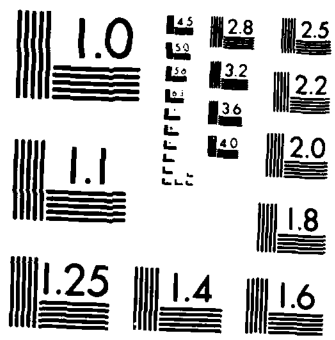
AD-A149 541 POST-FLOOD REPORT MISSOURI RIVER AND TRIBUTARIES SPRING FLOODS 1984(U) CORPS OF ENGINEERS OMAHA NE OCT 84 4/4

UNCLASSIFIED F/G 8/8 NL

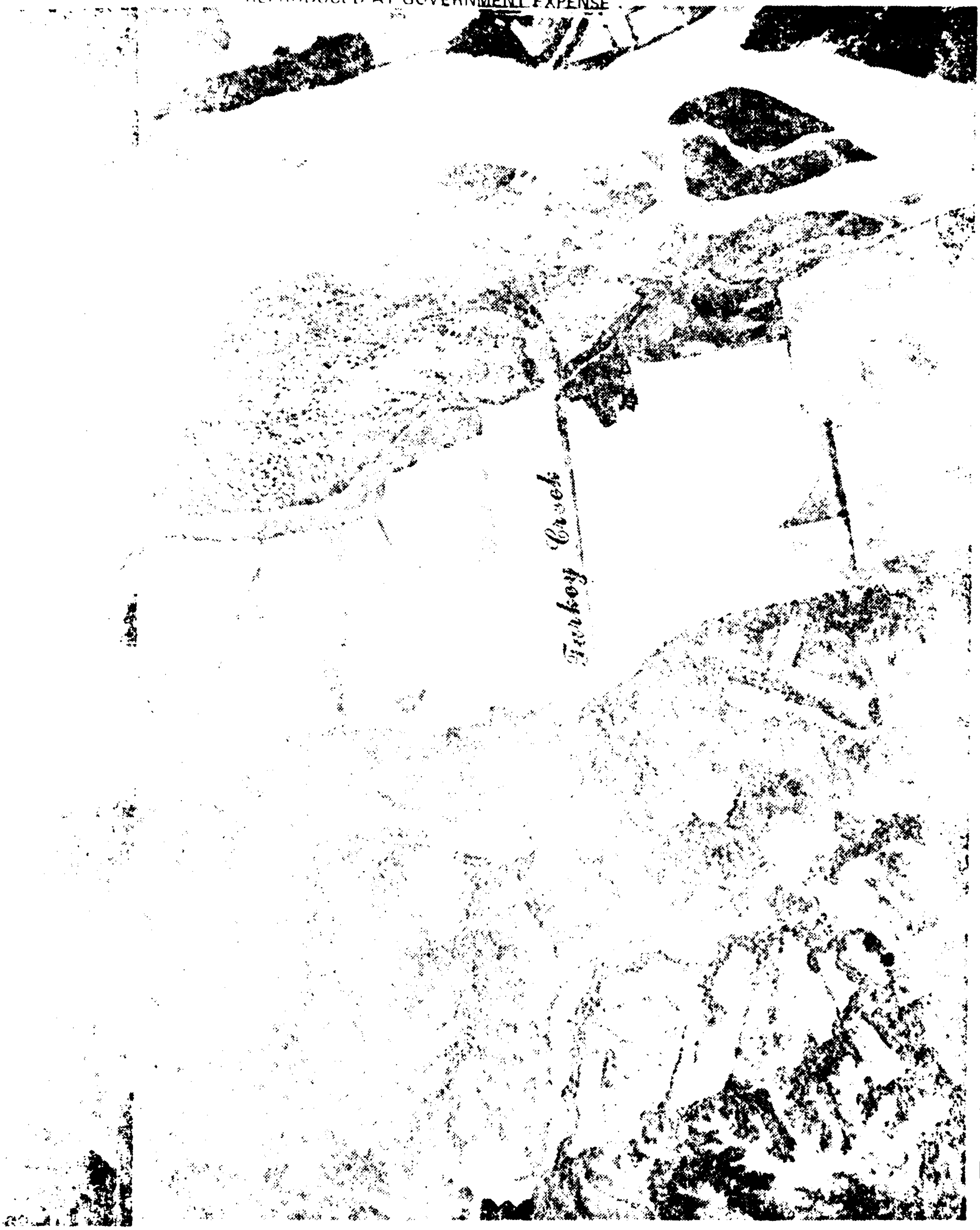
END

FILMED

DTIC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

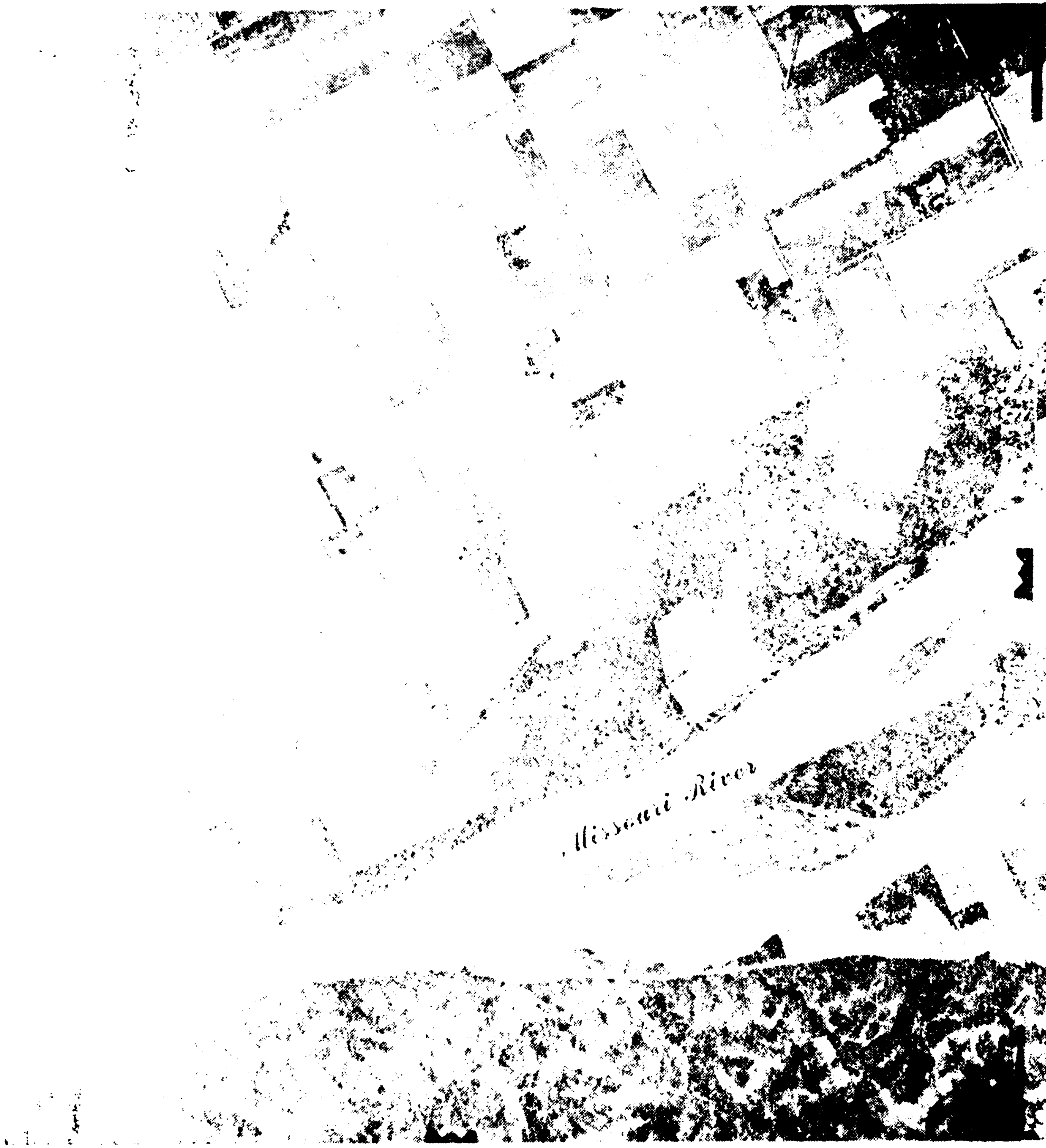


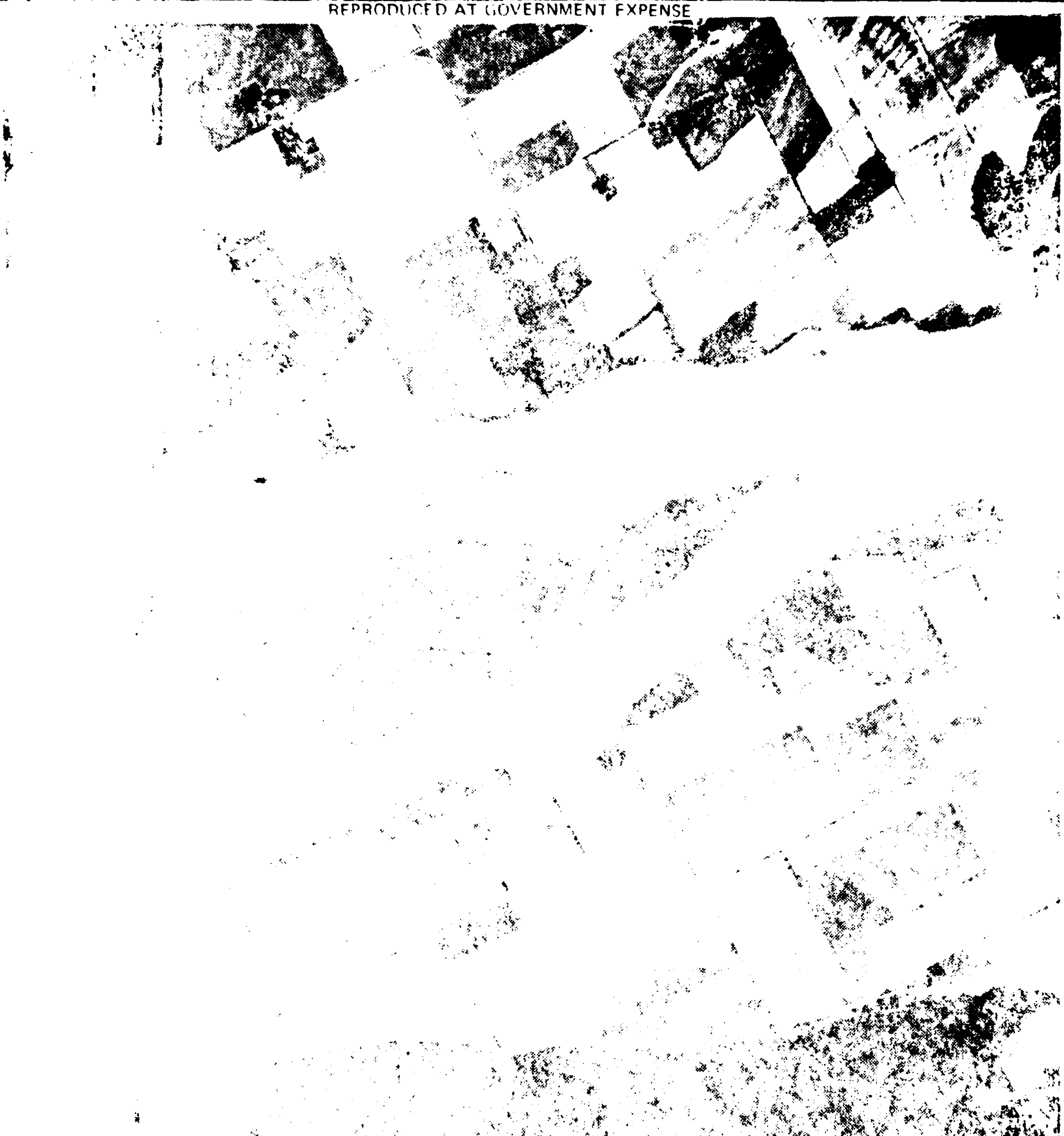
MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT 1984


Bow Creek

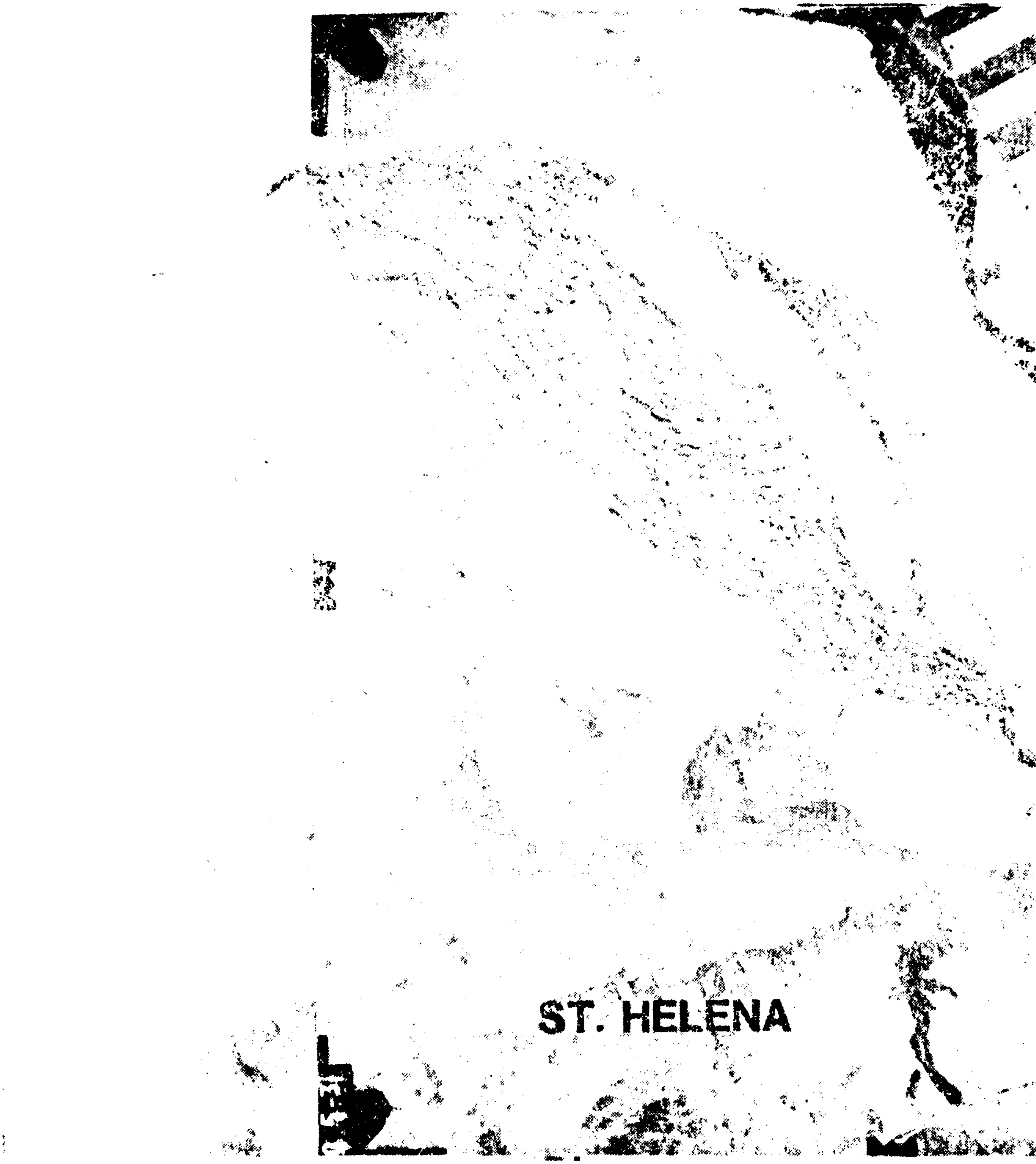

Missouri River



MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

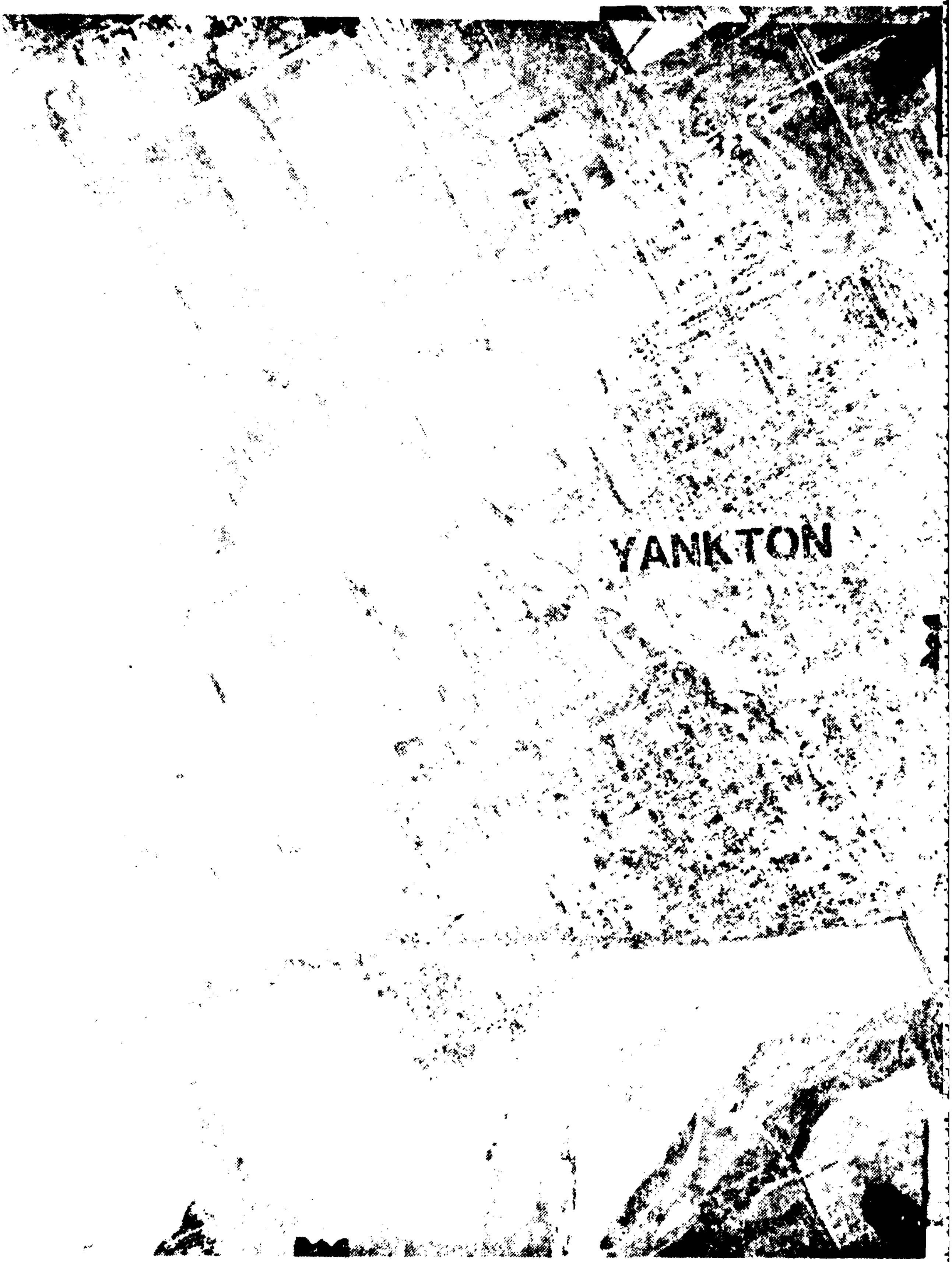

ST. HELENA

MISSOURI RIVER AND TRIBUTARIES

SPRING FLOOD 1984

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

PLATE


YANKTON


Hwy 50
Missouri River
Antelope

3

MISSOURI RIVER AND TRIBUTARIES
SPRING FLOOD 1984
U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
OCT. 1984

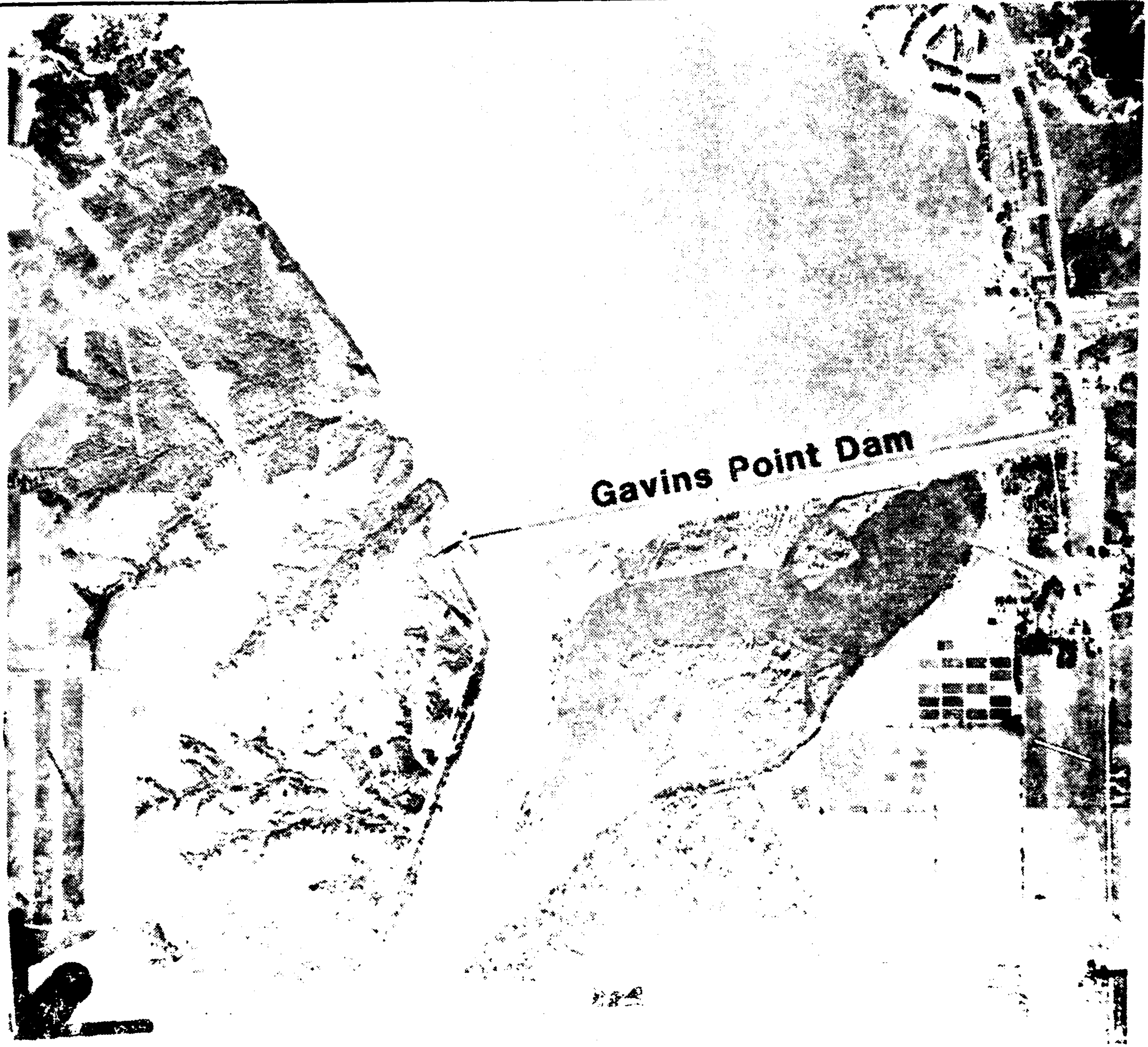
PLATE 110

MISSOURI RIVER AND TRIB

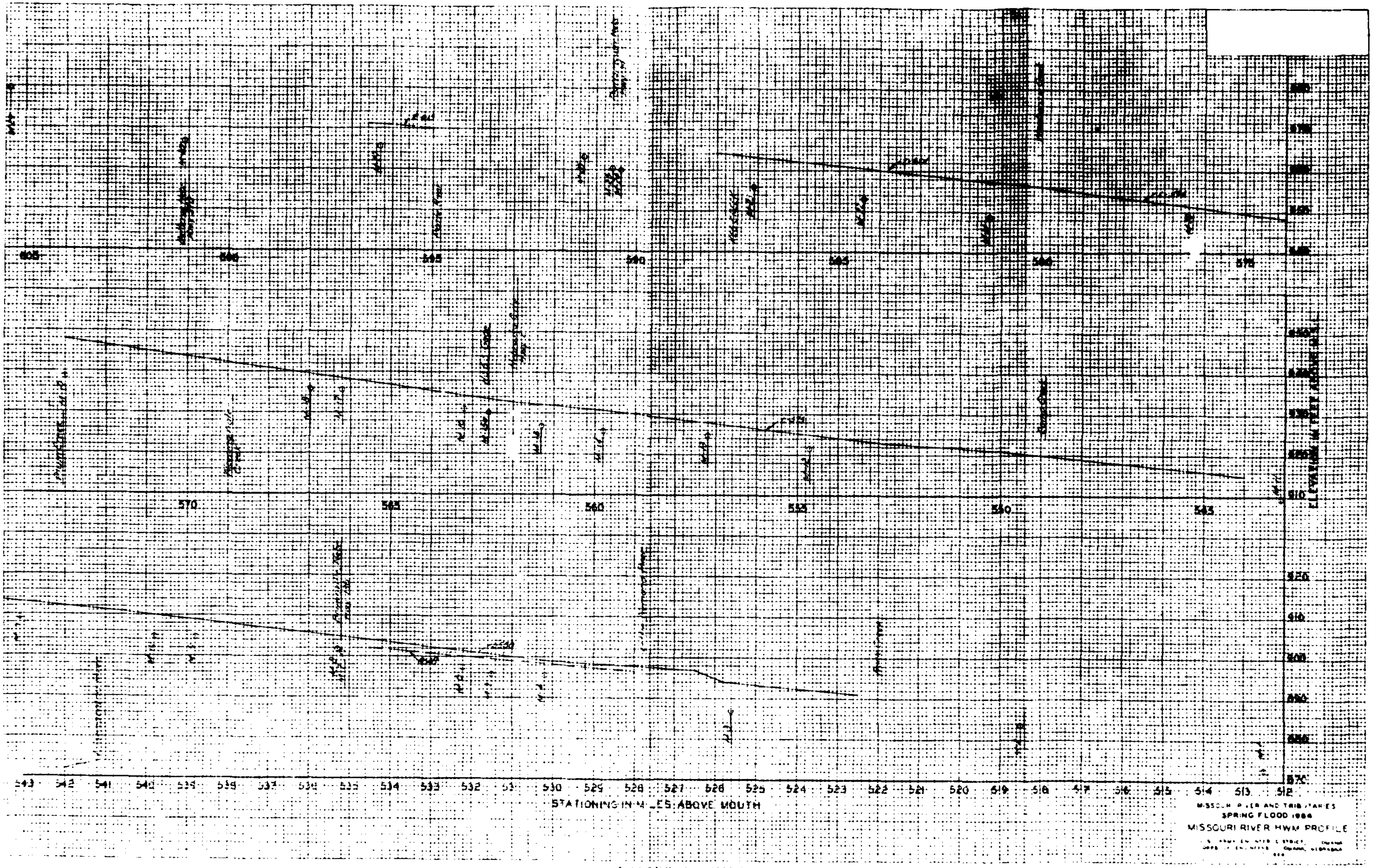
SPRING FLOOD 198

U S ARMY ENGINEER DISTRICT,
CORPS OF ENGINEERS OMAHA,

2

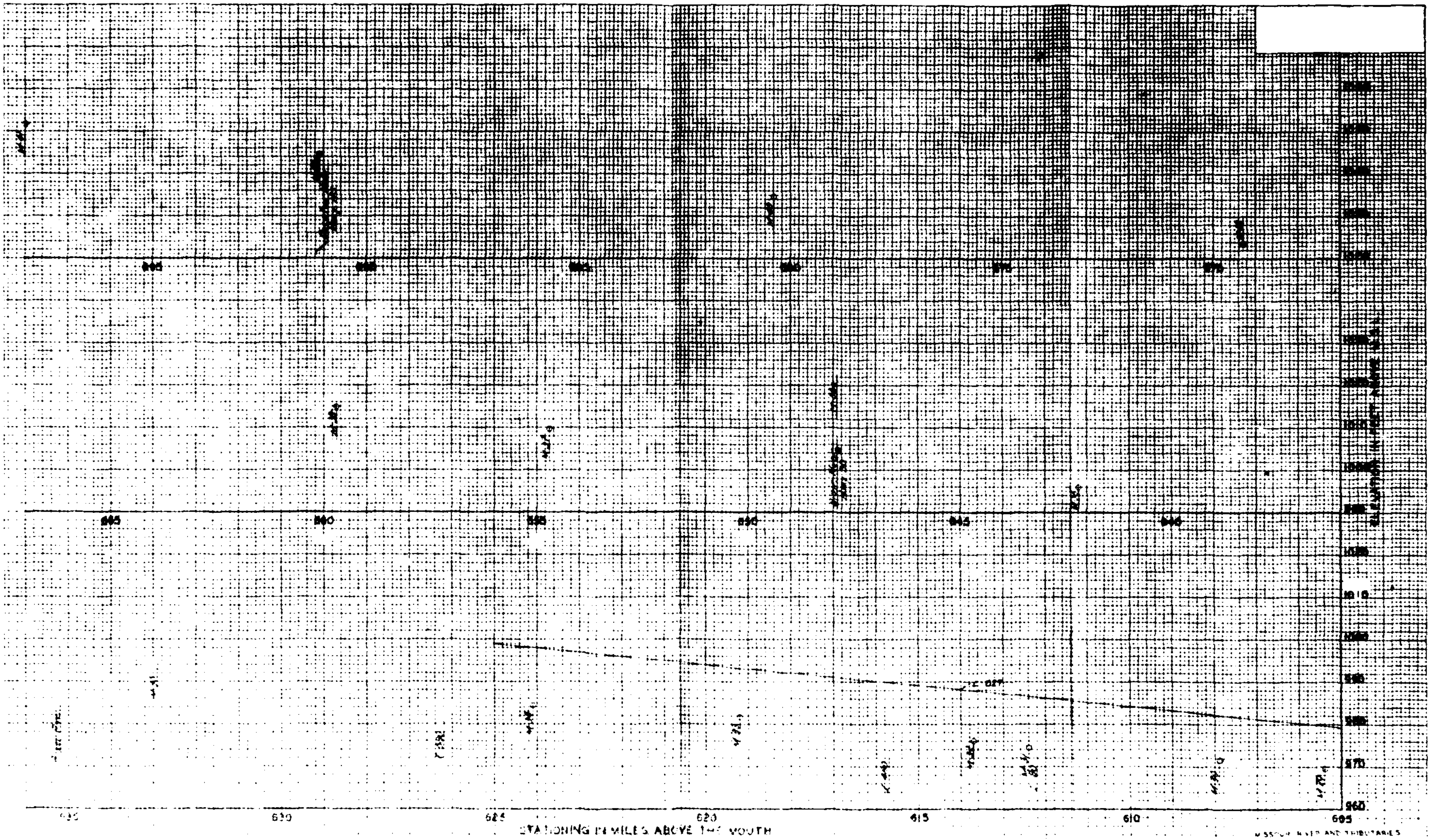


3



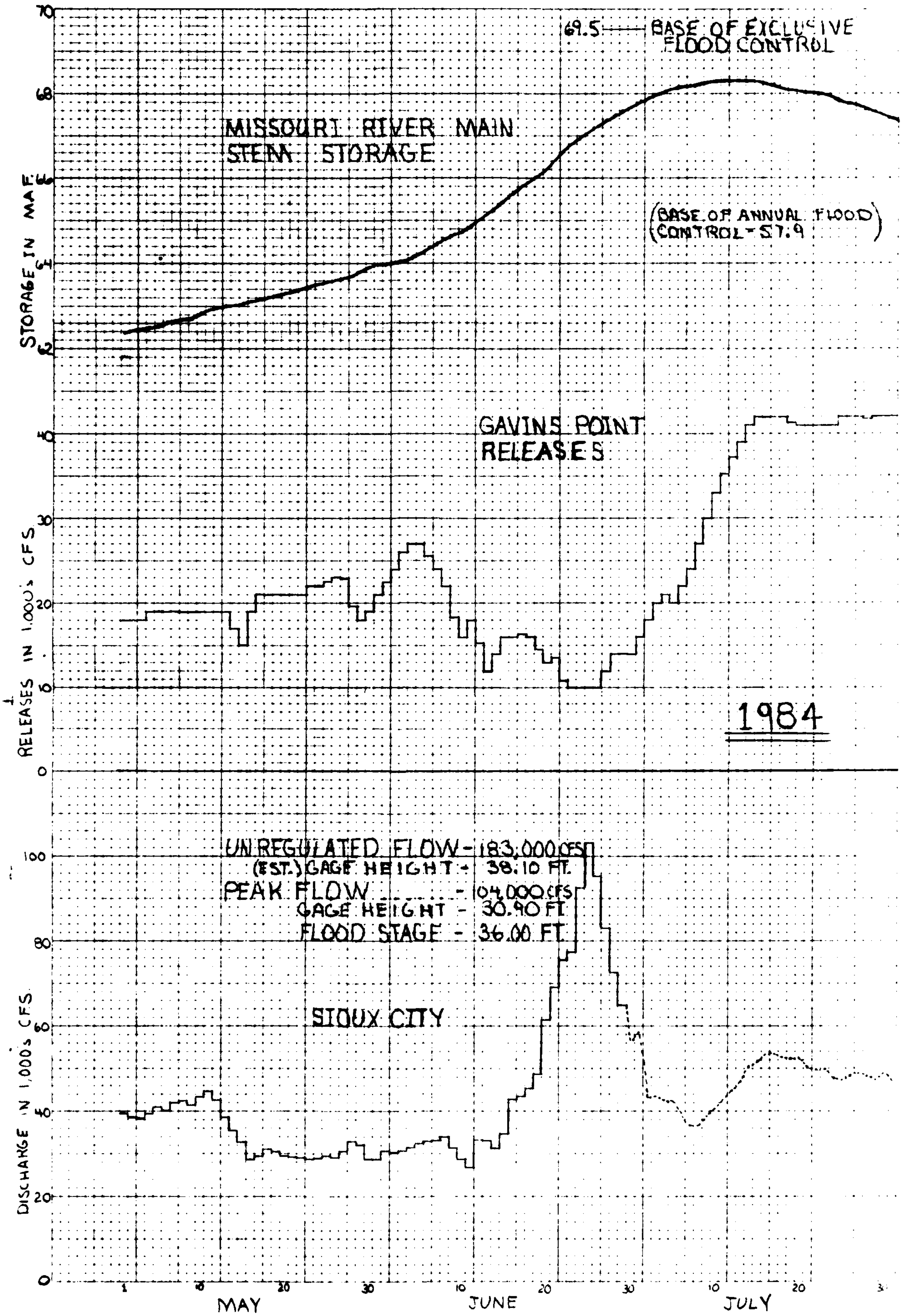
ELEVATION IN FEET ABOVE M.S.L.
STATIONING IN MILES ABOVE MOUTH
MISSOURI RIVER AND TRIBUTARIES
SPRING FLOOD 1984
MISSOURI RIVER HWM PROFILE

PLATE 18



MISSOURI RIVER AND TRIBUTARIES
SPRING FLOOD 1984
MISSOURI RIVER HWM PROFILE

PLATE


69.5 — BASE OF EXCLUSIVE FLOOD CONTROL
MISSOURI RIVER MAIN STEM STORAGE
(BASE OF ANNUAL FLOOD CONTROL - 57.9)
STORAGE IN MAF
70
68
66
64
62
GAVINS POINT RELEASES
RELEASES IN 1,000's CFS
40
30
20
10
0
1984
UNREGULATED FLOW - 183,000 CFS
(EST.) GAGE HEIGHT - 38.10 FT.
PEAK FLOW - 104,000 CFS
GAGE HEIGHT - 30.90 FT.
FLOOD STAGE - 36.00 FT.
SIOUX CITY
DISCHARGE IN 1,000's CFS
100
80
60
40
20
0
1
10
20
30
10
20
30
10
20
30
MAY
JUNE
JULY

END

FILMED

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